PHOTOGRAPHY
AND ITS CONTRIBUTIONS TO THE "BUSINESS" OF CRIME DETECTION

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PREFACE

Somewhere between the average man's conception of the operation of our modern agencies for crime detection, as he sees it from afar, and the operation of those same agencies according to the pen pictures of our modern fiction writers; the seeker for present day realities can find the true story of the "business" of crime detection as it is carried on by the modern Bureaus of Criminal Investigation which are today an integral part of every large city police department. "Business" I say advisedly, but as I believe correctly, for our modern agencies for crime detection are as highly organized, systematized and specialized as is any modern big industrial organization.

In the operation of the modern bureau of criminal investigation photography has come to play an ever increasingly important part. It is today the mechanical "eye" and "memory" of every police organization and its every new field or device is speedily added to the many tools of science which are today adding immeasurably to success on the battlefront of right and order.

Much has been written, as entertaining fiction, about the exploits of our present day "scientific detective". Scarcely

a week passes without a story of "True workings" or "Inside stories" of the work of the operators of Scotland Yard, the French Surete or some American Bureau of Criminal Investigation. These stories are entertaining reading. Many of them are true and represent the highlights of present day success in combating the machinations of the criminal elements in every community. Our publications on Photography often carry a story of baffling crime solved with the aid of the camera but I have not been able to find anywhere any attempt to set forth, evaluate and classify the many valuable contributions of photography to the science or "business" of Criminology.

It is my purpose, in the succeeding pages of this volume, to try and present as complete a picture as possible of the many uses which our modern police find for photography and to classify and evaluate the many branches of photography which have now found their place as a tool in the hands of our police organizations.

Much of the material is presented in the form of case histories, as this form of presentation not only represents the only form in which such material exists at the present time, but presents it in its most understandable and interesting form.

The chapter on the science of photography is in no sense a complete presentation of that most intersting subject. No part of it has been taken, either verbatim or in substance, from any of the standard works on the subject which are readily available to anyone who is interested in photography from a practical or operative standpoint. It has been written with a view to present to the average reader such a picture of the entire field of photography that he may readily understand the terms used and the material presented in the later chapters. To this end it is necessarily brief and condensed, but, it is hoped, sufficiently complete to serve its purpose as an integral part of the complete work.

The contributions of several men actively engaged, either in photographic work or the "business" of crime detection, have been of inestimable value in preparing this volume. It is a pleasant privilege to acknowledge at this point their very valuable assistance, and in particular, the material aid of the following:

Mr. Frank S. Holmes, formerly of the photographic department of Pinkham & Smith Co., Boston, Massachusetts,

Mr. Frank R. Fraprie, F. R. P. S., editor of American Photography,

Mr. Frank Sullivan, head photographer of the Bureau of Records of the Boston Police Department,

Captain James R. Claflin, Station 3, Boston Police Department, formerly head of the Bureau of Records and one of the foremost fingerprint experts in the United States,

Lieutenant Inspector Daniel O'Connell, of the Somerville Police Department.

Chapter I

AN OUTLINE
OF THE SCIENCE OF PHOTOGRAPHY

Photography Fundamentally

A Chemical Process

Photography is fundamentally a chemical process, dependent upon the proven action of light upon certain salts of silver. Primarily then, in order to produce a photographic image, we must have a transparent medium coated with a silver emulsion, enclosed in a light-tight box which must be fitted with some sort of devise for admitting a very small amount of light, for a very short interval of time. From these simple requirements we have developed the highly complex modern camera, and the specialized and complicated science of photography as we know it today.

It is perhaps unnecessary to follow the evolution of the photographic emulsion through the experimentation with various metalic salts in the days of Daguerre, and through the various complications of the "wet plate" system, which led eventually to the dry plates and films which are today's accepted mediums for the recording of photographic images. The make-up of present day emulsions combines silver nitrate with certain other chemicals which tend to govern the "speed" with which light will bring about the essential chemical reaction, and various dyes to render the

emulsion either sensitive or insensitive to certain colors.

Action of Color

The Orthochromatic Emulsion

To anyone who is conversant with the principles of color, and the various lengths of light waves set in motion by the various shades in the spectrum it will at once be obvious that blue, (the sky for example) would be the first color to register on the photographic emulsion, and that, inversely, red would be the last color to make an impression. Since we are endeavoring through the means of photography to reproduce a multicolored world in monochrome, it becomes essential to at least attempt some control of these color rays, and their effect upon our silver emulsion. It is apparent then, that in the ordinary photograph, blues register too rapidly while the opposite ends of the spectrum fail to assert themselves in time to balance the picture. Put into photographic language, the blues are over-exposed while the reds are under-exposed; hence in the ordinary snapshot, the sky is rendered a clear white, whereas a red apple, or an orange appear to be black. To overcome this improper rendition of color, the so-called orthochromatic emulsion was evolved. In simple language, it consists

of incorporating in the emulsion, a dye which will serve to hold back the blue rays, and give the yellows and reds a chance to register.

The Panchromatic Emulsion

The professional photographer is frequently faced with the problem of photographing objects which even the orthochromatic emulsion will not render properly in monochrome. For example, he may be required to copy a blue print, or to photograph a black sign with red letters; the ordinary orthochromatic film or plate would reproduce the former as clear white, and the latter as solid black. To meet this need, the photographic industry produced the panchromatic emulsion which is actually sensitive to all colors, so that even the familiar red dark-room light cannot be used in connection with these products.

The Color Filter

In order to still more accurately reproduce colors and shadings of color, the photographer frequently finds it necessary to use what is known as a "color filter", which consists of either colored gelatine or glass, and is devised to fit over the camera lens. To attempt a complete explanation of the uses and effects of color filters, would be a thesis

in itself, so that a brief outline must serve in this introductory chapter.

The color filter is used with orthochromatic emulsions, chiefly in landscape photography. The filter used in such work is usually light yellow in color, and it's purpose is primarily to "hold back" the sky and to differentiate between the various shades of green foliage. One of the most frequent errors which occurs when the amateur photographer attempts the use of color filters, is that of using too dark a yellow in choosing his filter, which results in what is known as "over-correction". The result is that his sky will be very dark grey - sometimes almost black - and the lighter greens will appear almost white. Paradoxically, this over-correction which often spells tragedy for the amateur, may be the salvation of the professional who frequently must over-emphasize certain contrasts in order to obtain desired results. The professional photographer uses color filters in conjunction with panchromatic emulsions, and an accurate - one might almost say a scientific - knowledge of the proper use of filters is essential to his success. A red filter is used in copying blue prints and in the photography of snow-capped mountains against a blue sky. A yellow

filter of proper density will cut through atmospheric haze, and make possible the photography of distant objects or will aid in the clarity of delineation when mapping from a plane. Green and blue filters are also used in order to either accentuate or omit certain colors. A well known professor of religious education had occasion recently to make copies of ancient documents in a Buddist monastery. The writings were originally in red, but had faded, and new characters had been written over them in bright green. Through the use of two filters it was possible to reproduce each set of characters unblemished, and as perfect as when written.

Broadly speaking, the use of color filters is of paramount importance with panchromatic emulsions, and is desirable on landscape subjects when an orthochromatic emulsion is used. The results from the use of a color filter,in connection with non-color sensitive emulsions, are nil.

<u>Development of the Negative</u>

Having secured the photographic image on the silver nitrate emulsion, it becomes necessary to bring it into visibility, and to make it a permanent record. This brings us to "dark-room" procedure - what is

commonly called "developing and printing". In order to obtain a visible image on our plate or film, it is necessary to bring about an oxidization of the silver which has been exposed to the light, this is accomplished by immersion in a "developing solution". There are many developing agents, having widely diversified effects upon the quality and character of the resultant image. Pyrogallol is extensively used by commercial photographers as being productive of sharply defined negatives with excellent contrast. Monomethyl paramidophenol sulphate, a coal-tar derivative usually sold under the trade name of "Metol", is a soft working developer tending to bring out the maximum of fine negative detail. It is slow working and is ordinarily used in conjunction with hydroquinone which is productive of maximum contrast, and is sometimes used alone for that purpose. Another widely used developing agent is paramidophenol hydrochloride, commonly sold under such trade names as Rodinal and Atol. This is perhaps the most active developer known and can be used successfully when diluted in seemingly impossible proportions. It is frequently used in very dilute proportions with development prolonged to an hour or more, in order to

produce maximum detail from under-exposed negatives. The recent trend toward small cameras, making it necessary to depend entirely upon enlargements for the finished product, has brought a number of new developing agents into the field. The tendency of these agents is to produce negatives with as little emulsion grain as possible, and, therefore, is productive of better enlarging quality in negatives. Foremost among these are Pyrocatechin and Paraphenylendiamine, and they are customarily used in combination with borax rather than some more vigorous alkalies which have a tendency to enlarge or emphasize the grain.

Developers are used in two ways, in trays or tanks. When used in a tray, development is carried out by the so-called "inspection method", and the judgment of the operator is the sole criterion for telling when development is complete. In the tank method, a schedule is worked out based upon strength of solution and temperature, and development is carried on for a specified length of time without inspection.

"Fixing" The Negative

From the developing solution, the embryo negative is transferred to the "fixing bath", consisting of

hyposulphite of soda with the addition of some other chemical designed to harden the gelatine of the emulsion base. The hyposulphite eats away the unoxidized silver from the emulsion, and leaves a semi-transparent image of reversed color values which constitutes the photographic negative. Next, the negative must be washed in running water for a considerable period in order to eliminate all traces of "hypo" crystals, after which it is dried and is then ready to be "printed" or reproduced on paper.

The Photographic Lens

Let us for the moment leave the mechanical details of photographic manipulation, and direct our attention to the "eye of the camera"- the photographic lens.

Functioning very much as does the human eye, the camera lens picks up light rays and brings them into focus in the plane of the sensitized film at the back of the camera.

The Meniscus Achromatic Lens

The original photographic lens was a very simple affair, patterned after the iris of the eye, and is known as a Meniscus Achromatic lens; which is to say, a convexo-concave lens nowadays used on inexpensive

hyposulphite of soda with the addition of some other chemical designed to harden the gelatine of the emulsion base. The hyposulphite eats away the unoxidized silver from the emulsion, and leaves a semi-transparent image of reversed color values which constitutes the photographic negative. Next, the negative must be washed in running water for a considerable period in order to eliminate all traces of "hypo" crystals, after which it is dried and is then ready to be "printed", or reproduced on paper.

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Functioning very much as does the human eye, the camera lens picks up light rays and refracts them into focus in the plane of the sensitized film at the back of the camera.

The Ordinary Photographic Lens

The original photographic lens was a very simple affair, patterned after the lens of the eye, and is known as a simple achromatic lens; which is to say, a convexo-concave lens entirely made of inexpensive

cameras which do not require setting for distance, or "focusing", and produces a reasonably sharp image only when the light rays are concentrated at the center of the lens. On small cameras a metal shield, having an opening considerably smaller than the area of the lens, is permanently affixed in front of it, thus assuring "sharp pictures" to the inexperienced amateur. This is what is commonly called "stopping down" the lens, and is accomplished on the better types of cameras by means of an Iris diaphram, which is ordinarily placed inside the barrel of the lens, and frequently between the lens elements.

The Rapid Rectilinear Lens

The meniscus achromatic lens has several drawbacks from the viewpoint of successful photographic procedure. It is "slow", a question which we will discuss a little later, and it is given to producing what is known as spherical aberation; which is to say, that perfectly straight horizontal or vertical lines in the subject are rendered as slightly bowed in the photographic image.

Through experimentation to overcome this difficulty was evolved the "rapid rectilinear" lens, which in reality consists of two meniscus lenses set back to back in a barrel, so that each tends to overcome the

spherical aberation of the other. The invention of the rapid rectilinear lens was a great step in photographic optics, for through the elimination of the distortion of image caused by the aberation, it was possible to operate the lens at larger apertures, thus cutting down the length of necessary exposure.

The Anastigmatic Lens

As the science of photography progressed and broadened in scope, makers of photographic lenses began to turn their attention to the elimination of astigmatism from their product. The professional photographer found his clientele more and more exacting, in the desire for "wire sharp" detail in the finished photograph, and in order to produce negatives of this quality with the rapid rectilinear lens meant stopping down so much as to render the necessary length of exposure highly impractical. Students of optics had already found that with the available types of lenses, operated at full aperture, a ray of light emanating from a given exterior point, did not come to an absolutely perfect focal point within the lens. This imperfection, known as astigmatism, resulted obviously in lack of minutely sharp definition in the negative image. The result

of endless endeavor and experiment on the part of the world's greatest lens manufacturers, was the production of the "anastigmatic lens", which,in further improved and perfected form,is the almost universally accepted equipment of today's better cameras.

Anastigmatic lenses are produced in many types of construction, and produce somewhat diversified qualities in the negative image, having been developed to fit the requirements of all branches in the art of photography in its present highly specialized form. One of the more prominent of the modern anastigmats is the "Tessar" produced by Carl Zeiss: consisting of three cemented parts in the front element and two in the rear element. This lens is perhaps one of the finest in existence for portraiture and fine landscape work. Its characteristics are; remarkable definition and color correction, plus a beautiful "roundness" of rendition,which makes it one of the most satisfactory of all lenses to operate. Another lens worthy of particular mention is the Goertz "Dagor", like most modern lenses, a two-element combination, but unlike many, each

element is a complete lens in itself. This objective is the almost universal choice of commercial photographers all over the world, and gives a wire sharpness and clarity of delineation unexcelled by any lens manufactured. Another quality,of great value to the commercial worker, is that,by using either of the elements separately,a lens of longer focal length is obtained, thus giving the operator the choice of two image sizes while obviating the need for an extra lens.

"Process" Lenses

Another group of high-grade anastigmats are the various so-called "process" lenses, of which those produced by Goertz and Ziess are probably the finest. These are used in the phases of photo-technical work such as photo-engraving, lithography, and photogravure; also to some extent in photomicrography. These objectives, while usually of long focal length and relatively small aperture, are the "aristocrats" of lenses. They must be absolutely free from all aberation and possess perfect color correction. They are manufactured with almost unbelievable care and precision, and are the most expensive of all photographic optical equipment.

"Wide Angle" Lenses

The professional photographer and even the serious-minded amateur is often faced with the need for an extraordinary lens in order to overcome a particular problem. When making photographs of interiors the operator frequently finds himself unable to set his camera far enough away from his subject to get in as wide a view as he desires. In order to cope with such an exigency, many types of "wide angle" lenses have come into use, the result being accomplished by constructing an objective of short focal length, but of great covering power. Such lenses usually work at small aperture, and provide an angle of view of about eight degrees, although one manufacturer markets a mechano-optical device for which an angle of one hundred twenty degrees is claimed. The chief drawback to the use of the wide angle lens is the tendency toward distortion of objects in the immediate foreground, even when the smallest apertures are used. The best makers have to a degree overcome this difficulty.

In direct opposite to the wide angle lens and its uses, is the "telephoto lens", which,as may be gathered from the name, is devised for the successful

photography of distant objects. By clever optical arrangement, two lens elements are set into opposite ends of a tube-like barrel which may be several inches in length, and a resultant objective obtained having the equivalent focal length of a much larger and bulkier lens. Telephoto lenses require extremely accurate focusing and should, for satisfactory results, be used with a color filter for the elimination of atmospheric haze. Dallmeyer of England has been particularly successful in the manufacture of fine quality telephoto lenses, and several of the expeditions which have filmed African big game, have been outfitted with batteries of these objectives.

"Speed" Of Lenses

The so-called "speed" of lenses is dependent upon the amount of light transmitted in a given length of time and is determined by the size of the lens aperture in proportion to its focal length, the focal length being the distance from the center of the lens to the emulsion surface, when the camera is focused on infinity. (That is, an object at an infinite distance such as the most distant clearly

visible point in a landscape.) Several systems of rating and standardizing lens speeds have been developed, of which the so-called "F" system is the one more universally used and the simplest to work out. The "F" value, or speed of any lens is its focal length divided by the diameter of the lens opening at its fullest aperture. Hence, if we have, for example, a sixteen-inch lens, (focal length) with an aperture diameter of 3 - 55/100 inches, and a five-inch lens having a diameter of 1 - 11/100 inches, while one looks much larger, yet their speed is identical, and with the same exposure will render negatives of identical density. The "F" value of both these lenses is 4.5, and such lenses are commonly referred to as "F 4.5" objectives. The difference in size is due entirely to the variance in focal lengths. The iris diaphram within the lens which governs the size of the aperture to be used, is ordinarily fitted with an indicator so graduated that each succeeding division as the opening is increased, exactly doubles the amount of light admitted. The scale most in use in this country, when applied to an F 4.5 lens, would read 4.5, 6.3, 9, 12.5, 18, 25.3, and 36.

Great strides have been made in recent years, in the development of high speed anastigmats, particularly in short focal lengths for use on motion picture cameras. Lenses with an "F" value of 2 or 2.5 are now extremely common. Carl Ziess has perfected an F 1.4 objective, in one- and two-inch focal lengths. When one considers that such a lens is ten times as fast as an F 4.5, and forty times as rapid as the old rapid rectilinear, it is evident that enormous progress has been made along this line. One manufacturer marketed a lens for a time, which was rated at F .99, but it did not cut an absolutely sharp image and was subsequently discontinued.

Depth Of Field Of Lenses

While on the subject of lenses and lens speeds, it would be well to devote a little time to the subject of depth of field, and its relationship to size of aperture. Depth of field, or depth of focus is descriptive of the scope of the lens to cut a sharp image when focused at a given point. Suppose, for example, we erect a series of stakes at intervals of six inches apart, and extending from the camera a distance of twenty-five feet. Our lens is a six-inch F 4.5, and we focus sharply on the stake twelve

feet away, making an exposure with the lens wide open. After developing we find the stakes from ten and one-half feet to fourteen feet away are perfectly sharp, while the others tend to grow more and more indistinct as the distance from the "sharp" area increases. This area of clear definition we term the depth of focus. Now let us make another exposure with the camera set as before, but with the lens aperture stopped down to F 9; we at once find that our depth of field has tremendously increased, possibly all the stakes from six feet to twenty feet being equally well defined. From this we must conclude that depth of field is directly dependent upon the size of aperture used. This quality of lens definition is also directly dependent upon the focal length of the lens used, the longer the focal length, the less the depth of focus at a given aperture. Another factor entering into the question is the distance from the camera to the object, there being much less depth of field at short distances. It is unnecessary to set out here the complicated mathematical formulae by means of which these distances may be figured for any lens at any aperture.

Focal Length Of Lenses

The question may very naturally arise as to what advantage a lens of one focal length has over another of shorter or longer length at a given aperture. There are two important factors to be considered: perspective and image size. Image size, from a given viewpoint, is entirely dependent upon the focal length of the lens used. The longer the focal length, the larger the image, and vice versa.

Everyone has at some time seen a snapshot photograph where the person's hand was bigger than their head, or where someone's knee occupied most of the foreground. This is caused by using a lens of relatively short focal length on a subject posed too close to the camera to make proper perspective possible, resulting in distortion of the image. For this reason, portrait studios almost invariably use a lens of from twelve to eighteen inches, so that close-up "head and shoulder" views may be free from any possible error of perspective, such as the ear nearer the camera being larger than the other.

Photographic Lighting

One of the greatest problems confronting the photographer is that of proper lighting. In the case of a landscape or an outdoor architectural subject, one is of course sometimes faced with the necessity of making a view from a certain angle, regardless of the direction of the light source. But even in such extreme cases, the time of day may be a vital factor in getting the best result, or a cloudy day may serve better than one of sunlight and shadow. Broadly speaking, outdoor photography under moderate sunlight, is productive of more satisfactory results than are possible under cloudy skies. The latter condition usually results in a rather flat and colorless rendition, with the subject decidingly lacking in character. On the other hand, the bright sunlight of midday is equally to be avoided, as being productive of harsh contrasts and opaque shadows which the lens cannot possibly penetrate without corresponding over-exposure of the highlights. If a careful study is made of the subject, it will usually be found that, under summer light conditions, between nine and ten in the morning, or between three and four in the afternoon will provide adequate sunlight

together with beautifully transparent shadows which will add materially to the charm of the resultant negative. The choice between morning and afternoon will of course depend upon what direction your camera is to face, keeping the sun as nearly behind the operator as possible. It is of course impossible here, to give a complete discussion of lighting outdoor photographs. The initiate in the photographic art will, if he be serious minded, find many exceptions to the general outline which has been provided here. A beautiful luminous effect may sometimes be obtained by photographing a subject against the sun, and giving it a deliberate over-exposure. A splendid architectural subject may be made or marred by the shadows of the ivy upon its walls. Successful artistry in outdoor photography depends, to a great extent, upon conscientious study of the lighting conditions, and upon the lessons drawn from unwise attempts.

Artificial Illumination

Indoor photography, while usually done under lighting which is open to more mechanical control, also presents its problems and its lessons.

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Artificial Illumination

Indoor photography, while usually done under lighting which is open to more mechanical control, also presents its problems and its lessons.

A generation ago, the finest portrait studios depended upon a large window or skylight for their lighting. This window faced north by preference, in order that the strength of illumination might vary as little as possible. Yet, even under the best of conditions, this illumination varied with the weather and with the season of the year. A complicated system of curtains and drapes were necessary, to curtail or increase the admission of light, as conditions demanded; and with all these aids toward control, the element of guess-work was large, and the ratio of wrongly-timed exposures large. We have had,in the last few years, great strides in the improvement of Photo-lighting equipment, so that today there is scarcely a studio worthy of the name but what is equipped with electric lighting facilities which deliver a constant intensity of illumination and make calculation of exposure absolutely certain.

Many types of artificial studio lighting have been used with varying success. The first experimental equipment consisted of lines of mazda lamps mounted on boards which could be raised or lowered as occasion demanded; then arc lights were used and even mercury

tubes. One form of lighting equipment which was very popular in studios not wired for electricity was the "flash cabinet". This devise consisted of a metal box with a translucent face in which flash powder could be exploded without flooding the studio with smoke.

The most convenient and practical type of studio lighting available today consists of a large curved metal reflector within which are mounted several high-powered nitrogen bulbs and the whole mounted upon a rolling stand. The bulbs are so wired that as many as are needed can be lighted at one time from a simply-manipulated switch on the side of the reflector. When a sitting is to be made, the subject is first posed in the desired position, after which the lighting units described above are rolled into place and adjusted so that the desired effect of shadow and highlight is obtained, and the exposure made. The operator knows in advance exactly how much exposure is required for the various combinations of lamps, and all failures contingent upon errors from this source are automatically eliminated. Sometimes, particularly in the portraiture of ladies, a "spot-light" is used in order to produce a strong highlight on the hair. This

device consists of one powerful bulb, mounted in a tube with lens and reflector, and having a focusing device so that any desired size of "spot" can be obtained. In some small studios only one lighting unit is used. In which case, a reflector or reflectors are used to lighten up the side of the face which is turned from the light. The usual type of reflector is a wide strip of glazed white linen, mounted upon an adjustable stand, which can be set to practically any desired position.

"Flash Powder" And The "Photo Flash Bulb"

The press or sports photographer has a lighting problem which is typical of his craft. He must be able to make pictures anywhere, anytime, and under any conditions. His equipment must work instantaneously, without failures, and must above all be distinctly portable. The round of a press photographer's work takes him to hotel lobbies, court rooms, schools, halls, business offices, and boxing arenas — perhaps even into dark cellars or on steamships — and he must be ready for any emergency. He must not fail! Up to about 1928 the only medium for such yoeman service was flash powder, a combination of magnesium and any of several metallic nitrates or chlorates. This powder was exploded in various types of "flash guns", either by means of a cap,

or a flint and steel arrangement. It was fast, powerful, and instantaneous, but it was also noisy, and gave off large quantities of acrid smoke. This was a pronounced handicap, for the photographer was frequently refused permission to "smoke-up" the premises of public and private buildings. Often the news photographer made his shots without permission, and had to depart in haste to escape physical reprisal. To overcome this difficulty, a German firm perfected the "photo flash-bulb". This devise is the same general size and shape as a one hundred watt nitrogen lamp, and contains aluminum foil in an atmosphere of oxygen. The usual incandescent filiament is replaced by a short metallic thread, coated with gunpowder. The base of the lamp is threaded to fit the standard lamp socket, and when the current is applied, the foil within the bulb is instantly fired. The bulb remains intact; there is no noise; and no smoke. One of the most remarkable features of this invention is the fact that only one and one-half volts of current are required to fire it, which makes it ideal in respect to portability. Today the press photographer carries in his hip pocket what

appears to be an ordinary electric flashlight, except that the bulb and lens have been replaced with a standard lamp socket. In his breast pocket is a folding reflector which fits over the end of the flashlight case, and photo flash bulbs are distributed over the rest of his anatomy. He has only to slip the reflector into place, insert a bulb, and he is ready for action anywhere. The foil within the flash bulb is completely consumed in approximately one seventy-fifth of a second, so that not only will they "stop" any ordinary motion, but the effect on the eyes of the subject is so slight as to cause no discomfort. In fact, in a brilliantly-lighted room it is scarcely noticeable. The light produced by the bulb is very powerful. Is is possible to make portraits of ordinary groups with an opening of only F 9 — a fact which is responsible for the production of several ingeneous devices for synchronizing the explosion of the flash with the action of the camera shutter. So delicate of adjustment are some of these devises, that sport photographs have been made with an F 3.5 lens at full aperture in one two-thousandth of a second. The shutter made the exposure while the combustion of the aluminum foil was

at its height.

"High Speed" Emulsions

We can hardly leave this subject of press and "speed" photography without a brief reference to the contribution which emulsion makers have made toward its progress. It should be made plain, first, that emulsions as well as lenses, have "speed", meaning the rapidity with which they respond to light. As in the case of lenses, several systems of tabulating emulsion speeds have been devised. The one most in use throughout the United States is one evolved by Hurter and Driffield, and is therefore generally known as the H & D system. The simplest explanation of this system, without attempting a lengthy technical discussion, is that the rating is numerical, and that comparitive speeds are in true arithmetical progression. As recently as 1925, the principal brands of plates and films in common use were rated at 350 H & D, and were considered as fast as could be handled without more or less intricate manipulation. There was, however, a constant demand from the news photographers for faster working materials which eventually brought about a competitive race between manufacturers in

order to meet the requirements and hold the business.

The Hammer Plate Company produced an emulsion rated at 500 H & D. Lumiere of France immediately announced their "Sigma" plate as 550. Close upon their heels came Ilford of England with the "Iso Zenith" rated at 700. Following this, Wellington, also of England, announced a plate having an H & D rating of 850. So the parade of speed has gone on and on, until we have on the market today, a wide selection of both plates and films of speeds ranging up to 1500 H & D. Many of today's emulsions, being color sensitive, react even faster under artificial light (because of the yellow rays), and may rate well over 2000 when used under electric illumination. Even the amateur who is primarily interested in snapshots is provided with a film operating at about 1000 H & D.

A similar trend toward "speed" is to be noted in connection with the moving picture industry where it was found that in some scenes the required intensity of light generated so much heat that the "make-up" liquidized on the faces of the actors. In order to cut down the light, a faster film was essential, and from this need was born Eastman's super-sensitive

panchromatic film, which is the most rapid medium for recording a photographic image yet to be produced.

Chapter II

PRESENT DAY POLICE ORGANIZATIONS,
THEIR FUNCTION,
THE PROBLEM OF IDENTIFICATION.

Present Day Police Organizations, Their Functions, The Problem of Identification

Our present day police organizations perform a twofold function from the viewpoint of criminology. They are supposed to prevent crime where possible, detect it where committed, and bring about the apprehension and conviction of the perpetrators.

The Attempt to Prevent Crime

The patrolman, on his "beat", performs the first function, that of preventing crime where possible. This he does through his knowledge of the neighborhood that he "covers", its frequenters, good and bad, and his ability because of this knowledge to detect anything unusual and suspicious that may take place. Should he detect the commission of crime where already committed,it is his duty to apprehend the perpetrators if possible, leaving his "beat", if necessary, in active pursuit of any discovered or suspected perpetrators of a known crime.

Function of the Bureau of Criminal Investigation

It is unfortunately the case, however, that the great majority of crimes are not committed in

proximity to a police officer, or even in such a way that he shortly becomes aware of their commission. The average crime is only discovered after its perpetrator has, as he hopes, safely removed himself from the scene of his criminal act. It is then too late for the average "man on the beat" to do anything effective in the way of actually apprehending the wrongdoer. That duty then becomes the active problem of the Bureau of Criminal Investigation, the "dective" branch of our modern police organizations.

Organization and Personnel of the Bureau of Criminal Investigation

The average Bureau of Criminal Investigation of a large city police department is headed by a Deputy Chief or Deputy Superintendent of police, usually with the title of Chief Inspector. He will have under him the usual organization of a police department subdivision: a Captain, one or more Lieutenants, several Sergeants, and as many Inspectors as may be thought necessary to effectively carry on the work of the department. The title of Inspector is peculiar to any member of this branch of police work throughout

the world, and an inspector is supposed to be chosen for the difficult task of detecting and apprehending clever criminals only upon his proven ability and evident capability for this work.

The qualifications demanded of applicants for this branch of police service vary throughout the world. Usually they are taken from the ranks of those "privates" of the police force — the patrolmen. They are often men of considerable education. In parts of Europe, notably in Austria, it is required that a man have the degree of Doctor of Philosophy before he can become an inspector of police.

Individual "Rights"

The Problem of Identification

From the earliest days of police organizations in those civilized countries where every man is afforded the protection of legal safeguards for "life, liberty and the pursuit of happiness", the work of the police has been made necessarily more arduous and exacting by the fact that conviction can only follow legal proof of the commission of crime and the identity of its perpetrator and the "suspect" on trial.

Let us then look, first, at the problem; and then at the several means and methods devised to combat it.

Through our city streets pass and repass vehicles of all sorts, each bearing a license number, conspicuously displayed. As these numbers are all recorded at the place where each vehicle is owned, they furnish an easy means of identifying the individual vehicles.

The people who pass in a double current upon either side of this stream of traffic are not thus registered; they bear no identification number; and have a place in the commonwealth simply by virtue of a personal name, recorded at the time of birth, and held simply in the memory of the individual himself and of his personal acquaintances. Under numerous circumstances, some of them by no means rare, this loose system, relying as it does upon the individual memory, and the willingness to be identified, proves insufficient or actually misleading, and there is thus great need of a surer method of definitely describing and recording each human individual. This would seem to be possible under all circumstances only by making

use of some mark or peculiarity permanently and unalterably fixed upon the body itself, and the best efforts of the anthropologists and other scientists have now for many years been devoted to this question.

The French writer of detective stories, Emile Gaboriau, wrote many years ago: "These difficult and delicate questions of personal identity are the bane of magistrates. Railroads, photography, and telegraphic communication have multiplied the means of investigation in vain. Every day it happens that malefactors succeed in deceiving the judge in regard to their true personality, and thus escape the consequences of their former crime. This is so frequently the case that a witty attorney general once laughingly remarked — and perhaps he was only half in jest — 'This uncertainty in regard to identity will cease only on the day when the law prescribes that a number shall be branded upon the shoulder of every child whose birth is reported to the Mayor'"[1]. Whimsical though this proposal is, it is literally carried out among many primitive peoples,

1 In "Monsieur LeCoq", Book I, Chapter XXI

and the absolute identity of individual bodies is rendered practically certain by the use of various artificial marks, such as tattooing, scarification, and the like.

The Answer of Science

Means of Personal Identification

Fortunately, however, for the comfort, peace of mind, and pride of mankind, nature has provided several solutions of this difficult problem and none of them subject the individual to the ignominy and discomfort imposed on cattle.

Every system of personal identification thus far devised through police practice, or scientific research, has as its basis the recording of some distinguishing characteristic of the human body by means of which that particular human being may be distinguished from every other human being. Some systems furnish only partial identification, while others furnish absolute identification. It may be well at this point to enumerate the principle systems now used or known in the order in which they have been developed, and later present each one more fully,

particularly as regards the adaptability of some photographic process to each.

The Bertillon System

In January, 1890, the Massachusetts Board of Prison Commissioners formally recommended the adoption of the French method, commonly known as the Bertillon system, for the identification of criminals, after a prolonged investigation into its merits by Mr. F. G. Pettigrove, the general superintendent of prisons for the state. Its adoption in the state prison soon followed with very satisfactory results. This system, concisely stated, is the classification of the measurements of those parts of the human body that do not change in size after a person has reached the age of about twenty-one years.

The inventor, M. Bertillon, was the son of a French physician who was a man of eminence in his profession. After completing the prescribed military service of a young Frenchman, M. Bertillon was appointed to a position in the prefecture of police in Paris. Soon after his appointment, he was so strongly impressed by the difficulties in the way of

the identification of the large number of criminals passing daily through his office, that he began to devise the system that now bears his name.[1]

His design was based on the fact that certain measurements of the body do not change after the period of full growth has been reached. These are, for example, the length and width of the head; the length of the middle finger, the foot, the forearm, and the outstretched arm; the height of the figure standing and seated; and the dimensions of the ear. As no two persons are exactly alike, it is practically impossible that any two complete sets of measurements of different persons should agree in every particular. Should it be found, therefore, after measuring an unknown prisoner, that the record of measurements agrees precisely in every detail with any record on file, it is practically certain that both sets are measurements of the same person. If then, the earlier record is one of a known criminal, the unknown prisoner will be inevitably identified with that criminal. This comparative process may be styled a mathematical demonstration of identification.

[1] Our Rival the Rascal, page 320

Besides introducing this use of certain measurements of the body, M. Bertillon perfected a method of notation of the color of the eyes, which is very exact; and this forms a part of his regular system today. He laid particular stress, also, on the desirability of obtaining photographs in profile as well as front views, on the ground that the outline or profile of the face changes less in the course of years than the full face, and that it can be less readily contorted or disguised. His system further includes what has been generally recognized as very important and trustworthy for the purpose of identification, the more ineffaceable scars or marks, noting their exact position and size.[1]

In 1862 M. Bertillon had the satisfaction of seeing the adoption of his system by the police of Paris, and within a few years afterward it became the recognized official system throughout France. Its use was soon largely extended throughout Europe, and it came to be used to some extent in this country. Its widespread adoption in this country,however, was arrested by the development of the more useful

1 Our Rival the Rascal, page 322

fingerprint system which is in general use throughout the world today. The Bertillon system, at best, furnished only partial identification, whereas the modern fingerprint system furnishes a method of absolute identification.

Dactyloscopy or the Science of Fingerprinting

The use of fingerprints as a method of identification is a very old practice. It was used during the earliest days in the East when a King or Emperor's thumb print was his sign and seal.

J. E. Purkinje, an eminent physiologist, read a paper in 1823 before the University of Breslau on the subject of fingerprints, but little attention was paid to it at that time.

Sir Francis Galton was the first to see the immediate need of fingerprint directories in the aid of crime detection. His first book, Fingerprints, was published in 1892. Two years later he published Fingerprint Directories. This lead to the appointment of a committee to inquire into the new system, and to its adoption by Scotland Yard.

It was introduced into the United States a few

years later, and was soon a part of the system of criminal identification the world over.

Identification Through "Earographs"

Today the criminological world is all agog over a new development in the "business" of crime detection. A ten-year search for two ears just alike has led to the discovery of a new weapon against crime. In October, 1932, Dr. Theron W. Kilmer, noted New York physician, told police officials at the seventh annual convention of the National Identification Association, meeting in New York City, of discovering a "criminal ear" that appears twice as often among gangsters, thieves, and thugs as among honest citizens.[1]

In addition, he has worked out a system of classifying ears as an aid to trailing wanted men. Because of his researches, such strange terms as "flap ears", "earographs", and "one-o'clock ears" may soon hold important places in the vocabularies of American detectives. While "earographs" are not expected to supplant fingerprinting as a final check upon identity, Dr. Kilmer does foresee their wide

[1] Popular Science, Nov. 1932, page 15

use as an additional test to supplement fingerprinting. A criminal seeking to escape arrest can disguise his features in many ways. He can dye his hair, thin out his eyebrows, grow a beard to cover his face, wear heavy glasses that hide his eyes, but, since the ear becomes useless if it is covered, criminals practically never attempt to disguise it.

The mental picture of a wanted criminal's ear will often assist a detective in picking out his man no matter how he is otherwise disguised. And an ear can be studied without arousing the suspicion of the one under observation.

Use of Ultra-Violet Rays

X-Ray Pictures

A new use for invisible ultra-violet rays or "black light", which may prove highly important to the scientific detective, has just been announced by a Washington, D. C., physician, Dr. Thomas A. Poole. In making more than two thousand X-ray pictures of the nasal sinus cavities, located in the bones of the skull near the nose, he discovered that those of no two

individuals are identical. And as the cavities keep the same shape throughout life, X-ray pictures of them are always the same. Tissue decays soon after death, but bone does not. Thus, bodies dug up years after a murder may be identified by X-raying the skulls, Dr. Poole declares. The Washington police, as well as representatives of several insurance companies, have studied this new method of identification and are reported to be very enthusiastic over it. [1]

The methods of identification discussed briefly in this chapter are the principal ones that are either in actual use today or those that give the greatest promise of actual utility in the future. Those persons who may be interested in a more complete presentation of the subject of Personal Identification are referred to the excellent work under that title written by Harris H. Wilder, Professor of zoology, Smith College, and Bert Wentworth, former Police Commissioner, Dover, New Hampshire, and published by Richard G. Badger, The Gorham Press, of Boston, Massachusetts, in 1918.

[1] Popular Science, Jan. 1932, page 120

Chapter III

ROUTINE POLICE PHOTOGRAPHY
THE BUREAU OF RECORDS

In attempting to outline the various branches of photographic science which are now numbered among the weapons of society in its battle with the underworld, the problem of order and arrangement presents itself. That line up or arrangement which combines the dual features of the simple-to-complex order, together with a logical time order, suggests itself naturally to a work of this kind because it follows necessarily that the simplest of the many branches of photography were developed first and were first adopted to police practice, followed later, and in logical order, by the more and more complex branches of photography as they came to be developed. With this plan in mind let us proceed to a consideration of that most elementary branch of routine police photography, that part which comes into play when the suspected criminal is first brought to police headquarters.

"Mugging" and "Booking" of Suspects at Police Headquarters

Any person who is arrested as the suspected perpetrator of a crime is first brought to police headquarters to be questioned by Inspectors of the Bureau of Criminal Investigation. Following this questioning he is photographed and fingerprinted in order that he may be identified with some known criminal whose record is known to the police, though

perhaps under another name, if that is possible.

Two pictures are taken of every prisoner brought to police headquarters; a front view of his face and a side view of his head. The prisoner is seated in a chair, the back of which contains a rest for his head. With his head held firmly against this rest his face is at a definite distance from the "mugging" camera before him and his pictures are certain to be in focus and to exactly fill the area of the photographic negative upon which his image is thrown.

The illumination is usually provided by two mercury vapor lamps, one on either side of the subject. These supply a very even illumination and bring out detail to a marked extent.

The "mugging" camera has a negative carrier very much like the slide carrier of a stereoptican viewer or projector. It is divided in the middle, vertically, and thus two pictures can be made on the negative which it contains. The front view is first made on the left half of the negative, followed by the side, or profile view, made on the right half of the negative, the carrier being shifted from side to side in order to bring successive halves of the film in position behind the lens for each exposure.

perhaps using another pose, if that is possible.

Two pictures are taken of every prisoner brought to police headquarters; a front view of the face and a side view of the head. The prisoner is seated in a chair, the back of which contains a rest for the head. With the head held firmly against this rest his face is at a definite distance from the "magazine" camera before him and the pictures are certain to be in focus and to be the same scale as the photos made recently upon which the camera is focused.

The illumination is usually provided by two mercury vapor lamps, one on either side of the subject. These give a very even illumination and bring out details to a marked degree.

The "magazine" camera has a sliding carrier very much like the slide carrier of a stereopticon or magic lantern. It is divided in the middle, vertically, and thus two exposures can be made on the negative successively. The front view is first made on the left half of the negative, then the side, or profile view, on the right half of the negative, the carrier being shifted from side to side in order to bring successive halves of the plate in position behind the lens for each exposure.

When a group of suspects are brought in together to be photographed they are lined up before a section of the wall divided vertically by lines which represent certain height levels and which are so marked in feet and inches. In this way the relative heights of each person in the group are seen at a glance. This wall panel has at its top a large clock, a large calendar of the page-a-day type, and an indicating dial showing the month of the year and the day of the month, all of which appear in each picture taken. This arrangement makes possible the presentation of a great deal of information in such form that it can readily be seen at a glance and obviates the necessity of taking several separate pictures and filing them in an envelope together with as many record cards. This device is a comparatively recent innovation developed at the Boston Police Headquarters. Its use has now become quite general throughout the larger cities of this country.

After being photographed each suspect is fingerprinted and certain of his bodily measurements are noted, together with the color of the hair, color of the eyes and any distinctive marks or scars which he may bear upon his face or body.

All of this information is then turned over to a clerk who works out the fingerprint formula for that particular in-

dividual and compares it with those of two files of similar formulas, one of all suspects who have ever been booked at that particular place and another which lists the formulas of all wanted persons who may be in that vicinity.

The Bureau of Records

It is not difficult to understand that the records of criminals and suspects which have just been discussed may, in a fair sized city, grow to the proportions of a large library. Where this has happened many large police departments have created a new police subdivision to take over this work and named it The Bureau of Records.

This new bureau works with the Bureau of Criminal Investigation but is not subordinated to it either in organization or in operation as it has, besides the various functions already described in this chapter, several other important duties to perform. It is, among other things, the photographic department of those police organizations of which it is a part.

It is the duty of the Bureau of Records to take, prepare, and file, all photographs which may be needed as evidence by the Bureau of Criminal Investigation, or any other police division for that matter, which may be needed in the prosecution or presentation of a case.

Photographs in Court

Hardly a case goes to trial today in which photographs do not appear, either as simple aids to the jury in visualising the scene of a crime or an accident, or as direct and important links in the chain of actual evidence brought against a suspected criminal and vital to his conviction.

Not long ago Mr. Frank Sullivan, chief photographer of the Bureau of Records of the Boston Police Headquarters, spent over three hours in court, entering forty-nine different pictures as evidence in a single case. This gives one some idea of the extent to which photographs are used in present day court procedure. In preparing these photographs for this case Mr. Sullivan had to make four or five copies of many of them, one for the judge, one for counsel on each side of the case, and one or two for general use. Each photograph had to be presented to the court as a separate exhibit, passed on as evidence by the judge, argued over in many cases by counsel for both sides, and finally either accepted or rejected as evidence in the case, often over the exception of either of opposing counsel. Such a photograph may later become the basis of an appeal to a higher court should the verdict in the case in question be adverse to the side entering the objection.

Photographic Equipment of the Bureau of Records

The equipment of the Bureau of Records contains practically every device known to the science of photography. The darkroom equipment is of the latest type used in commercial photographic laboratories, and is designed to produce photographs in large numbers on short notice, if that should be necessary. Cameras range usually from the 4 by 5 folding Graphic to others often as large as 11 by 14 inches in picture size. These are all provided with lenses of various speeds and focal lengths for various purposes and conditions that may be encountered. The convertible Protar, made either by Zeiss or Bausch & Lomb, is a favorite in many Bureaus.

The incidental photographic equipment of a police organization varies of course with the size of the department. Many of the larger departments have very complete apparatus for the making of photomicrographs. Other small departments lack this entirely.

The Fluorescope

Often the police photographer is called upon to produce in court a copy of some paper, document or entry in a book which cannot be brought into court or even taken to headquar-

ters to be copied. In this case he must go to that place where the desired evidence is kept and endeavor to photograph or copy it there, often under conditions that are very trying and unsatisfactory from a photographic standpoint.

One of the greatest aids to the man confronted by this difficult situation is the Fluorescope, man's nearest approach to the ultimate in his quest for "cold" light. This device, which is made in various sizes, is the product of a Dutch firm and resembles the usual colored glass slides used in the darkroom safelight. It is similar in its action to luminous paint and after a short exposure to light will glow or "fluoresce" with sufficient intensity to affect a photographic negative in the same way as will any other kind of light.

In practice, the Fluorescope is placed under the document to be copied after being "charged" and the photographic negative is placed on the other side of the paper. After a short time the writing on the document is reproduced latently on the negative to be brought out later by ordinary development.

Chapter IV

PHOTOGRAPHY
AND THE
SCIENCE OF DACTYLOSCOPY OR FINGERPRINTING

- 1 -

"Dactyloscopy, or the proving of identity by the digital patterns, consists of studying the patterns found upon the tips of the digits. There is no more difference between the digital designs of a child who is just born, and those of the same subject at two years, five years, ten years, twenty years, than there is between successive enlargements of the same photographic negative. The physiological wear of the skin, or, in other words, the age, does not change in the least detail the design, which is not modified, either pathologically or by the will of the subject. In fact, even burns, whether due to hot metal, hot oil, or boiling water, merely raise a blister which, after bursting, leaves a place for new skin. One cannot distinguish the imprints taken before and after the burn. The finger patterns are never identical in two subjects, for if two individuals could show the same design, the matter would lose all practical interest. Finally, the designs formed by the papillary ridges (in particular those of the finger tips) have the triple characteristics of perpetuity, immutability, and variety; they remain the same during the life of

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the subject, who cannot change them. Certainly not a single judicial error can be cited which may be imputed to them". -- M. Edmond Locard, Director of the Police Laboratory of Lyons, France. 1914.

The term "Dactyloscopy" is formed of two Greek words, dactylos, a finger and skopein, to examine, and means literally: an examination of the fingers.

The Definite Meaning of "Finger Prints"

The framework of a finger consists of three bones; the phalanges, which form hinge joints where they come together. The basal or proximal phalange is the one nearest the palm at the base of the finger, followed in turn, proceeding toward the tip, by the middle phalange, and end or terminal phalange.

The thumb has only basal and terminal phalanges. The toes correspond exactly to the fingers in the number and arrangement of their phalanges, two in the first, or "great" toe, and three each in the others, in all, fourteen in an entire foot or hand.

The lower, or palmar, surfaces of all the phalanges are covered with friction skin, bearing ridges, but it is only upon the prominent cushions of the terminal phalanges, the "finger balls", that they arrange themselves into definite patterns. Elsewhere the ridges run in somewhat irregular course, with a tendency to either slant or curve; and thus, while in the case of chance impressions, any of the phalanges may prove of the utmost importance, it is to the finger balls of the end phalanges that our attention is especially directed. These are the "Finger Prints" of ordinary parlance, and thus far have occupied the main attention of the experts. [1]

The Types of Patterns

In 1823 Purkinje made a careful study of the finger patterns and grouped them in nine groups or types, to each of which he affixed a definite name; the oblique loop, the spiral, the double whorl, the almond, and so on. Galton, writing in the 80's, made a much simpler grouping of the types, and embraced them all under three, the

[1] Personal Identification, page 185

Arch, the Loop, and the Whorl. These he designated by their initial letters and upon them he founded his now famous "ALW" classification. This was the foundation of the present classification, which differs mainly in the recognition of a fourth class, that of the Composites, introduced for practical purposes by Sir Edward Richard Henry, and intended to include all forms of patterns not readily included under either arches, loops, or whorls. To this class would be referred patterns with two loops, loops with pockets, various sorts of spirals, and all forms of eccentrics. The classification of finger prints is rendered so simple by this means that with a little patience any one may soon be able to distinguish these four classes at sight.[1]

It is not possible, in a work of this kind, to illustrate the types of fingerprint patterns with pictures, or to so adequately describe them that the reader will have a clear and definite idea of the distinguishing characteristics of each. Those desiring such information are referred to

[1] Personal Identification, page 187

Wilder and Wentworth's book on Personal Identification, chapter five, the several works by Galton and Henry or those of the more recent American writers, Seymour, Kuhne and Evans.

Fingerprinting Is the Most Important Agency for Crime Detection

Of all the phases of scientific crime detection, fingerprinting unquestionably has the greatest number of thrilling captures to its credit. Every large city in this country has its experts who have tracked down wanted men through the mysterious loops and whorls, arches and islands, that appear in ever varying patterns on individual fingers.

Practically every police department in America is now equipped for fingerprint work. At the New York City headquarters, police files contain more than a million prints. In Washington, D.C. the "fingerprint clearing house", maintained by the Department of Justice, is growing at the rate of nearly half a million prints a year. This great

crime fighting machine, with its trained experts, its army of clerks, its battery of typewriters, pounding out answers to nearly two thousand queries a day, is unifying the police of the nation in a scientific offensive against the underworld.

Transmission of Fingerprint Information

For national and international use, a code has been worked out that enables an expert to send a fingerprint description by radio or cable to all parts of the world. Not long ago, such symbals bridged the seven thousand five hundred mile gap between a Berlin, Germany, radio station and Buenos Aires, Argentina, resulting in the capture of an international confidence man. By teletype, the actual pictures of fingerprints are now flashed between distant cities, and hardly a mail plane flies east or west today without carrying in its pouches fingerprint copies vital to the apprehension of some wanted criminal.

During the year 1932, television was added to the many existing agencies for rapidly conveying fingerprint information to all parts of the world.

The actual picture of the fingerprint of a wanted murderer, broadcast from California, was picked up in Boston and reproduced as a permanent likeness on paper within two hours of the time that it actually went on the air.

<u>The Development and Growth of Fingerprinting</u>

So rapid and widespread has been the adoption of fingerprinting that few people realize that it has been in use for only thirty years. As early as 200 B. C., Chinese emperors signed official documents with their thumb prints, but it was not until the nineteenth century that scientists gave serious study to the subject. After years of research, Sir Francis Galton, cousin of the great naturalist, Charles Darwin, published a book in 1892, showing that all fingerprints are different. Then, in 1901, Sir Edward Richard Henry, head of the London police, established at Scotland Yard the system of criminal identification now used throughout the world. [1]

[1] Popular Science, Mar. 1932, page 35

No Two Fingerprints Are Alike [1]

Glance at the ball of your thumb or fingers and you will notice that the ridges swirl about in a definite pattern. You are the only person on earth with that exact ridge formation. Faces may look alike, bodily measurements may duplicate, names may be identical, but the lines and loops on every hand, experts say, form an individual pattern that has no counterpart. Take the classic case of the two Will Wests.

In 1903, a negro by that name entered the Federal penitentiary at Leavenworth, Kansas. As he was being photographed and his measurements taken, the record clerk thought he recognized the face. He compared the measurements just made with his files and found that they were exactly the same as those in an envelope marked "Will West". A photograph in the envelope showed the identical features of the new prisoner.

"That's me, all right", the amazed negro admitted when he saw the likeness,"but I don't see where you got my picture, because I've never been

[1] Popular Science, Mar., 1932, page 35

here before".

Investigation showed that another negro with the same name, the same features, and the same bodily measurements was still serving a life sentence in the same penitentiary for a murder committed in 1901. When fingerprinting was later introduced, officials took the thumb prints of the two Will Wests. Even a layman, at first glance, could tell they were entirely different.

Imagine the number 1,000,000 followed by fifty four ciphers. That staggering figure compared to one represents the chances of two fingerprints in this world being the same, according to the French authority, M. Balthazard. The prints that are most alike are those of identical twins. In the case of two brothers, policemen in Berkeley, California, and the Ellis twins, who came to the notice of Scotland Yard in England, the patterns were at first declared identical. Under the microscope of the expert, however, important differences appeared. Not only are fingerprints distinctive, but the patterns formed by these tiny nonskid

ridges remain the same throughout life. Your hand may grow fatter or slimmer, but the patterns, like the design of a lace curtain, will stretch or contract but remain recognizably the same. A criminal may disguise himself in a dozen ways, grow a beard and change his name - one character of the underworld has been known to have had ninety aliases - but the telltale ridges and valleys on his fingertips will trip him up.

Perpetuity and Immutability of Fingerprints[1]

Criminals have attempted in many ways to mar their fingers so they would leave no fingerprints. One burglar seared his hand on a red hot stove, a confidence man tried to shave off the ridges with a sharp razor, and gangsters have been known to try to destroy them by grinding with pumice stone or applying acids. But in every case the ridges developed again, exactly as they had been before.

When the fingerprint identification system was first introduced into America, one scoffing detective at the New York City headquarters submitted to a grueling test. After being finger-

[1] Popular Science, March, 1932, page 36

printed, he placed his hand on a whirling grindstone until the tips of his fingers bled. Then, he was fingerprinted again. The faint lines of the ridges were still sufficient to identify the prints from among hundreds of others.

Not long ago, a fourth offender in New York made a desperate effort to beat the Baumes Law, which sentences such felons to life imprisonment. In the patrol wagon, after his arrest for an attempted holdup, he slashed the tips of his fingers with a bit of metal taken from the end of his shoelace, so that his fingerprints could not be recognized. However, as soon as the superficial cuts healed, the ridges reappeared, giving an infallible clue to his identity. While deep cuts destroy the ridges, they, themselves aid in identification. For, under a microscope, no two scars are ever alike.

With amazing accuracy, the markings of these practically indestructible ridges lead to the wanted criminal. A Scotland Yard detective found sixty different fingerprints on one bottle at the

scene of a crime. After weeks of work, he traced fifty nine of the sixty prints to reputable employees of the robbed store. But the one exception, the sixtieth print, led to the wanted man. When the famed Leonardi Da Vinci painting, "Mona Lisa", was stolen from the Louvre in Paris, some years ago, a single fingerprint on the frame resulted in the arrest and conviction of the daring thief.

How Fingerprints are Left at the Scene of A Crime

In the whole subject of identification by finger prints, the public is most interested in that branch of it where the author of a crime is discovered by an imprint left at the scene, unknown to himself; or where in addition to other proofs, further evidence is furnished by some imprint, more or less clear, found where the crime has been committed. Let us then consider the steps taken by the police in actual practice to so record discovered fingerprints that they may be of practical use in detecting the perpetrator of a crime, the physiological explanation

of how fingerprints are made, the methods of evaluating discovered prints and lastly, a few cases from actual police work which illustrate some of the ingenious methods employed under unusual circumstances to record the latent finger print.

Police Procedure

In the city of Lyons, France, as soon as it is discovered that a crime has been committed, the patrolman, or whoever makes the discovery, immediately telephones to the Police Laboratory. The informant gets a formal order not to disturb anything and an officer is placed in charge to guard the place and see that the fingerprints are not obliterated. The agents attached to the Bureau of Criminal Investigation can thus arrive in time to discover the traces, stains or prints, which are taken to the laboratory; or, if that is impossible, they are photographed on the spot. In practice it is an exceptional case where no trace is left. It can be seen that the expert ought to be the first to enter the place before anything has been handled, otherwise there will be found only the prints of the idle and the curious and possibly those of the police

themselves. If there ever was needed the warning "Hands Off", it is at the place where a crime has been committed.[1] The procedure in Lyons, France is cited because it illustrates representative police practice of today at its best and because that city was one of the pioneers in perfecting what may be called effective "police standard practice", under the guidance of one of the foremost exponents of scientific crime detection, M. Edmond Locard.

Development of Latent Fingerprints - Powders and Their Use

An explanation of how the imprints left accidentally at the scene of a crime can be developed to the extent of being useful is undoubtedly in order at this point.

The friction ridges which make up every digital pattern are thickly studded with microscopic pores and through these there is a continuous flow of perspiratory secretion generally imperceptible to the naked eye. When a finger comes in contact with a smooth surface that is cold and dry, the im-

1 Personal Identification, Page 260

prints made by the ridges are left more or less distinct, on the article touched. Where it is possible these imprints are photographed, generally larger than the original. Sometimes it is necessary before taking the photograph to bring out the imprints with some reagent, using black powder if the imprints are on a light surface, or on white paper, and white powder if the imprints are on glass or dark surfaces. It will at once be seen that the visibility of these accidental imprints is thus largely increased on account of the adhesion of the powder to the moisture or oily secretion left by the ridges, and the earlier the attempt to bring out these marks the better chance of success, for there is great liability of failure if the impression has become perfectly dry.

The black powders in common use are generally animal black, graphite, lampblack, powdered willow charcoal, black antimony and others of a similar nature. These are used ordinarily to develop marks on paper or light surfaces. On glass or dark surfaces, "gray powder" composed of chalk and white oxide of mercury, is used, although there are pre-

pared powders for sale, both black and white, that are excellent for the purpose. A word of warning may not be amiss; in rolling black powder back and forth on paper to bring out the imprints, care must be taken that the powder does not gather into little balls, as snowballs increase by rolling. In the application of the white or gray powder a fine brush of camels hair is used and the powder applied very lightly, in other words "patted or dusted on", and then as lightly brushed or blown off with a small bellows, not with the breath. For covering large objects like safe doors and table tops with powder, the fingerprint men of the New York City headquarters and other large police organizations are equipped with compact machines that scatter the powders evenly and then blow away the superfluous dust.

M. Stockis of Liege, Belgium has originated a process of photography by indirect illumination without coloring, and M. Edmond Locard of the Laboratory of Police in Lyons, France, has been wonderfully successful with very fine reagents, and up to the present has obtained the best results

paper powders for sale, both black and white, that are excellent for the purpose. A mode of wrapping may not be easier; in rolling black powder over and thrown on paper to bring out the imprints, care must be taken that the powder does not gather into little balls, as sometimes it increases by rolling. In the application of the white or grey powder a fine brush of camels hair is used and the powder applied very lightly, in other words "patted or dusted on" and then gently brushed or blown off with a small bellows, not with the breath. For covering large objects like safe doors and table tops with powder, the fingerprint men of the New York City police department and other large police organizations are equipped with compact machines that scatter the powders evenly and then blow away the superfluous dust.

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with the oxides of lead, particularly the red oxide. Still other trials with litharge and dioxide gave extremely clear results.

The practical application is as follows: if a suspicious imprint is developed with black powder, it can at once be compared with an inked imprint from a suspect, and if there seems to be doubt one way or another, both are enlarged 5 or 6 diameters and the points of identity in each are checked up.

Comparison of Supposedly Identical Fingerprints.

The commonest method of comparison is to mark the points of identity, one after another, as found, by means of lines drawn from them to the margin and bearing letters or numbers by which to distinguish them.

Another method devised by Albert S. Osborn, is to divide each of the two enlarged photographs into squares, both exactly alike, with the squares occupying identical positions on each, and then examine them in order, square for square, noting the points of identity in each.

Seymour uses still another method, that of making skeleton tracings. These he makes on tracing paper; one from the suspected print and one from a

print of the accused, and compares them by placing them together and holding them up to the light.

A new method for accurately classifying single fingerprints has been devised by Chief Inspector Harry Battley of Scotland Yard. He uses a round magnifying instrument having a plain glass window below, marked with concentric circles. The center of this transparent "target" is placed on a certain point of the print. Then the position of the various ridge lines in relation to the circles is compared to the position of similar lines on other prints until a perfect match is made. One California expert has calculated that if ten points on two prints are identical, the chances are 1,652,000 to one they were made by the same finger.

These methods are necessary only when the two prints in question seem to be very similar. When certain and definite differences are seen by the eye, these more careful methods are not required.

Special Procedure With the Use of White Powder.

Where the traces are developed by white powder a different method is followed, as it is desired ordinarily to compare the lines comprising the develop-

ed trace with the black lines made with ink from some digit of a suspected person. In the taking of the photograph the plate is put in the plate holder with the film side away from the object photographed and after the plate so made is completed, another plate is made from this, as lantern slides are made and the photographs printed from the last plate. This will take considerable time; to save which, for quick comparison, an imprint can be made from the digit of a suspected person by the use of white ink on glossy black paper. This has the advantage of being ready for comparison in a minute or two. Still another method suggests itself that has been tried with good success, that of taking the print of the suspect on a cleared piece of glass or film as a photographic negative with the sensitized paper underneath and not in contact with the inked side. This will give results of surprising brilliancy, showing the ridges as white lines with the details brought out in a wonderful manner. These can be quickly printed and compared with the imprint that has been developed with white powder.

The advantage of reversing the colors in the photograph comes from the fact that nearly everybody

has examined ridges as black lines on a white surface and but very few have examined them as white lines on black.

Basic principles of Identification from Impressions

It is admitted that identification does not consist merely in finding forks or interruptions of the ridges in homologous positions; the angular value of the forks is still necessary to consider, also the length of these interruptions and even the width of the corresponding lines. It follows then that in a light trace or where the center of the figure is effaced, it is necessary to be particularly observant about the appearance of each of the points under observation.

Locard summarizes the principles of Identification from Impressions, as he sees them as follows:

Three cases may be presented:

1. There are more than 12 evident points; the impression is clear; - absolute identification.
2. There are 8-12 points; limited cases; certainty depends upon:
    a. the clearness of the impression;
    b. the rarity of the type;

c. the presence of the center of the figure or the triangle, in the part that is decipherable;

d. the presence of pores;

e. the perfect and evident identity of the breadth of the ridges and furrows, of the direction of the lines and the angular value of the forks.

In these cases certainty of identification is to be established only after the discussion of the case by one or more competent and experienced specialists.

3. There are very few points; in this case the print, taken by itself, does not furnish certain identity, but only a presumption proportional to the number and clearness of the points.[2]

<u>Basic Principles of Photographing Fingerprints</u>

The methods of developing chance impressions found at the scene of the crime, as used by the authorities of Scotland Yard, and described in detail by the Commissioner, Sir Edward R. Henry, in his

[2] From La Preuve Judiciaire par les Empreintes Digitales - Edmond Locard. PP. 16-17

manual are quoted as follows:

"Evidence as to the identification of persons by means of finger prints, when given by competent witnesses, is accepted in Criminal Courts.

Crime investigators should know the method by which finger prints are compared for the purpose of deciding questions of identity so that, with the aid of a reading glass, they can readily determine whether or not any particular impression possesses sufficient clearly defined characteristic detail for the purpose of fixing identity.

Any article with a smooth surface is likely to retain imprints of value if touched. Finger prints on rough surfaces are, as a rule, of little use.

Latent impressions can be developed with the aid of powders. If the marks are on blades of knives, plated goods, or on surfaces of a dark nature, "grey" powder is used. If the impressions are on paper or on surfaces of a light color, graphite or lampblack will develop them. These powders ought to be used sparingly with a fine camel hair brush. All superfluous powder must be

blown or brushed away.

Unless the prints are latent, powder should not be used at the time of discovery by the investigating officer, as it sometimes happens that the powder reduces the area available for comparison by obscuring some of the characteristic detail. It is always possible for a skilful photographer to obtain a satisfactory photograph without the use of powder when the detail is discernible, though faint.

When fingerprints are on part of a broken window, the remaining pieces should be preserved so that they might, if necessary, be fitted together, thus supplying evidence as to a particular piece being part of the window broken. Similar precaution should be taken in other instances, if considered necessary.

In all cases where fingerprints are found at the scene of a crime, the officer should endeavor to ascertain whether or not they are the prints of any person residing within the house, or those of a police officer or other person who may have arrived earlier on the scene.

It should be distinctly understood that fin-

ger marks which do not disclose clearly defined detail when viewed through a reading glass are generally found to be useless when photographed.

At Scotland Yard much care and thought has been given to the photographing of finger prints, and as a result efficient appliances have been installed. They include a large camera with sufficient bellows extension to enable prints to be enlarged six diameters, two powerful electric arc lamps which, by means of overhead rails, can be placed in any position; and an enlarging lantern capable of enlarging a finger print sixty diameters.

Finger perspiration marks on a piece of glass are photographed by placing the glass between the jaws of a small vice. The vice has a fitting attached which permits of its sliding up and down a metal rod. This metal rod has a heavy base to keep it steady. A thumbscrew is fitted so that the vice can be fixed to the rod at any height. A box about 18 inches deep of cross section 6 inches square, lined with black velvet, is placed on its side with the open end immediately behind the finger mark. The rays of light from the lamps are not permitted to reach the far end of the interior of

the box, thus ensuring a dead black background. The lights (one on each side of the lens) are arranged in such position that the ridge lines when focused on the screen of the camera will appear light on a dark ground, a second plate has to be made from the first by contact in the manner one would make a lantern slide. The printing is done from the second plate. The first plate when placed in the dark slide is reversed, that is to say, the film side is away from the lens. If this is not done, when printing from the plate, left will appear for right in the finished print. Conversely, if the side of the glass on which the finger impression appears is turned away from the lens the first plate is not reversed.

Finger perspiration marks on blades of knives or on plated goods are photographed in a similar manner, but the velvet lined box is not needed. The lighting is sometimes difficult since the article must be placed and lighted in such a way that the impression will appear on the screen light on a dark ground. A little patience is rewarded by obtaining the desired result.

Similar imprints on glass bottles and tumblers are photographed by the preceding method, but the bottles are filled with a black or dark red fluid to get the necessary contrast. Tumblers can be filled with a similar liquid when the marks are on the outside of the glass, but, as a rule, better results are obtained by placing a piece of dead black paper in contact with the whole of the inside surface of the vessel with the exception of that part covered by the finger print. Another sheet of this paper prevents light from entering the top.

The convexity of bottles, etc., is sometimes the cause of reflections appearing over a part of the area covered by the finger print. This is removed by altering the position of the lamps.

When finger prints are found on the smooth side of corrugated glass, the numerous reflections are removed by filling the uneven surface with black printing ink.

The ridges of fingers when impressed heavily on a candle create furrows similar in pattern to those of the ridges. Before being photographed

Similar imprints on glass bottles and ampules are photographed by the preceding method, but the bottles are filled with a black or dark red fluid to get the necessary contrast. Tumblers can be filled with a similar liquid when the marks are on the outside of the glass, but, as a rule, better results are obtained by placing a piece of dead-black paper in contact with the whole of the inside surface of the vessel with the exception of that part covered by the finger print. Another sheet of this paper prevents light from entering the top.

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The ridges of fingers which impressed heavily on a candle create furrows similar in picture to those of the ridges. Before being photographed

such imprints are treated in the following manner: the impression is covered with printing ink, superfluous ink being afterwards removed until only that in the furrows remain. This is a similar process to that adopted by printers when preparing an engraved name plate for press.

Finger prints in blood or dark impressions on a light surface are photographed as of black on a white surface.

It sometimes happens that when a finger covered with a liquid such as blood is impressed heavily, the pattern left indicates that of the furrows, not the ridges. If on comparison this is found to be the case, a photograph showing the true sequence can be obtained by reversing the first plate and making a second by contact.

Slow plates and a developer likely to produce maximum contrast should be used.

It is not possible to give definite information concerning the exposure of plates, so many factors have to be considered. When photographing a faint mark illuminated by two arc lamps with slow plates, F22 stop and enlarging six dia-

meters, twenty to thirty seconds exposure is given.

It is not suggested that these hints cover the whole field of this interesting subject. Each case must be dealt with as occasion requires. It is thought, however, that they may assist those possessing a good knowledge of photography who are called upon to photograph finger marks found at the scene of crime.

Finger print exhibits, as prepared by Scotland Yard for production in court are enlarged six diameters. A sufficient number, usually about twelve, are prepared for distribution amongst the Judge, the Jury and Counsel.. A few unmarked copies are always available in case they might be required".

Recently Discovered Aids to Photographing Fingerprints

These suggestions on the photographing of finger prints quoted directly from the manual of Sir Edward Richard Henry are undoubtedly the most complete compilation of such data available today. However, for the sake of completeness, it may be well to mention briefly some other methods of reproducing or bringing out latent prints under unusual circumstances.

The Use of Transmitted Light and Chemical Fumes

Photographs on glass may often be photographed by transmitted light without using powder and, occasionally, a print on a dark highly polished surface may be photographed by direct light shining obliquely on the fingerprint. Fingerprints on paper may often be brought out clearly by sprinkling the paper where the fingerprint is thought to be with finely powdered sugar of lead (lead acetate) and then placing it in the fumes of ammonia which will blacken the lead acetate wherever it has adhered to the latent impression.

The Use of Acids and Inks

The etching action of diluted nitric acid on paper and of hydrofluoric acid on glass is sometimes used. A piece of paper on which there is a finger print may be floated, face downwards, on dilute ink, or the ink may be brushed lightly over a spot where a finger print is believed to be. The oily lines of the digital patterns repel the ink, leaving the ridges light and the valleys dark when the pattern becomes visible.

The Use of Vapor Reagents

For rough fabrics and some papers, vapor reagents, such as iodine or osmic acid vapor, are used. Iodine vapor is most sensitive but the latent prints it brings out soon fade. Osmic Acid, on the other hand, leaves a permanent print, but fails to develop faint impressions.

Such methods as these are seldom used and they should be used only by experts. On important cases, it is best to bring the object showing the fingerprint into court whenever it is possible, but if the print is on a piano or a safe, it may not be practical to do so. To protect a fingerprint until it may be photographed, a watch glass or a celluloid shield such as is used by doctors to protect vaccinations may be placed over it and fastened by means of adhesive tape.

"Lifting" a Fingerprint

Sometimes a fingerprint may be "lifted", or, in other words, transferred to a piece of photographic film. A piece of clear film about three inches square is used. The print is dusted carefully with aluminum powder and the gelatin side of the film is moistened slightly so that it is tacky. Then the

film is pressed carefully into contact with the fingerprint and, as carefully, peeled off again. A fingerprint should usually be photographed before being "lifted" in case of accident. Fingerprints that are smeared or blurred are generally useless. After some experience it is possible to distinguish between an old and a new fingerprint. If an old print has to be photographed, gentle heating will help the powder to adhere. The acid method, previously described, sometimes has to be used on old fingerprints that would fail to respond to any other treatment.

<u>The Fingerprint Camera</u>

One of the most valuable articles of photographic equipment for use in fingerprint photography is the Folmer and Schwing fingerprint camera. No focusing is required and no extra lights are needed. The front of the camera is placed in actual contact with the surface on which the finger print has been found and brought out by the use of any one of the various reagents previously described. The lens, which is set back into the frame of the camera a distance equal to its focal length, will then give a 1-1 enlargement, or in other words reproduce in actual

size, the fingerprint which it is automatically focused upon. The camera carries its own lights within that part of its frame which extends beyond the lens and these flash on automatically at the moment of exposure when a small lever on the side of the camera is pushed. This camera is considered standard equipment in all police bureaus. Where circumstances require the use of more versatile equipment. the Clinical Camera, made by the same concern, is often used.

Chapter V

PHOTOGRAPHY
AND THE
SCIENCE OF POROSCOPY

Identification Where There is Little Or No Digital Pattern

In the consideration of the study of finger-print identification up to this point attention has been directed mainly to the study of printed impressions of the friction skin surface, as they appear on paper or some other surface capable of retaining an impression. For the still more detailed study that may be necessary in the identification of only a few ridges, with, perhaps no pattern at all (for even this is at times possible), the attention must be directed to the actual skin surface, and its details followed by the aid of the microscope.

Probably the most sensational development in the science of fingerprinting is Dr. Edmond Locard's study of the pores along the tops of the ridges. This famous scientific detective of Lyon, France, reports that the shape, size, and number of these sweat pores are different in the case of different individuals. The number of openings per square inch, he found, ranges from sixty to one hundred and seventy.

By means of his "dactyloscope", a special pore-studying super powerful microscope, Locard trapped

a notorious jewel thief operating in Lyon. Locard himself has described that now classic case of Boudet and Simonen about as follows:

On June 10, 1912, the apartment of M. Chardonnet, at No. 6 Rue Centrale, was broken into, and several pieces of jewelry, together with 400 francs in money, were stolen. There were no witnesses, and no clue to the thieves; but a rosewood box, in which the jewelry had been kept, was literally covered with blurred finger marks. These were developed with carbonate of lead and photographed. On comparing these with the collection at headquarters, an assistant named Chambon discovered that certain of the impressions belonged to a man named Boudet, who had been sentenced several times for theft before. On looking up the records it was found that Boudet habitually operated with a pal by the name of Simonen. The two were placed under arrest, and impressions of their hands, other than the fingerprints were taken. There were obtained from the prints which covered the box a fair impression of the middle phalange of the left middle finger of Boudet, and one of the small area of the left palm of Simonen. From the

ridges alone, in the usual way, there were established 78 points of identity for the first and 94 for the second, yet, as the accused would not confess, the case was brought before the assizes. Here the jury was shown enlarged photographs of the regions in question, taken both from the impressions on the box and from the men themselves, developed in the same way. In addition to the ridge details emphasis was laid upon the correspondence of the sweat pores, of which, in the area from Boudet's finger, there were 901 separate pores. All of these, allowing for difference in the amount of pressure, were shown to correspond exactly; while upon the area from the palm of Simonen there were more than 2000 such correspondences.

As a result of this demonstration, which presented such an enormous number of correspondences, the jury was convinced, and Boudet and Simonen were each sentenced to five years at hard labor. It is to be emphasized, first, that there was absolutely nothing else than the marks on the rosewood box that could be brought up against the men, and secondly, that the box had been so much handled by

both thieves that there were no distinct patterns, and but few places which were not surcharged by overlapping impressions. Locard himself remarks that without the slightest doubt the sweat pores played the principal role in convincing the jurors, who could not deny this overwhelming mass of evidence.[1]

Can Fingerprints be Falsified?

Thrillers of fiction and nerve-tinglers of melodrama have often centered about master crooks who wore magic gloves that left the fingerprints of innocent people at the scene of a crime. The question is often asked, "Could this be done in real life?"

The unanimous answer of scientific criminologists is "no". The lines and ridges might be duplicated, but they would leave no characteristic marks of secretion from the sweat pores, and the absence of the pores themselves would be evident

[1] See article by E. Locard; "les Pores et l'identification des criminels", in Biologica, 2 an. #24 December 13, 1912.

in the forgery. Under the lens of a Locard's dactyloscope, a false fingerprint could be distinguished in an instant, for under a powerful microscope a single friction ridge has the appearance of a curving mountain range with a chain of volcanic craters along the top.

Chapter VI

PHOTOGRAPHY
AND THE
"EAROGRAPH"

The Story of the Development of the "Earograph" System [1]

The "Earograph" and the system of personal identification of which it is a part, has not as yet been officially added to the tools of scientific study already in use by our modern crime fighting organizations, but it has every chance of being so adopted in the very near future.

A strange little dialogue with himself, some ten years ago, played an important part in starting Dr. Theron W. Kilmer, widely known criminologist and identification expert, on his study of ears. One day, he was looking over rogues' gallery photographs at police headquarters and picked up a side view.

"This", he mused to himself, "is Mike Mulligan. How do I know it is Mike Mulligan? Well, it looks like him. If I take away this ear does it still look like him? Not so much. Well, suppose I take away Mike Mulligan and leave the ear, can I still recognize him?"

He decided to find out. He began to study ears, compare ears, photograph ears, seeking to discover whether every ear is as distinctive as the license plate on a motor car or whether two or more ears are often identical.

[1] Popular Science, Nov., 1932, page 15

On the street, in church, on subways, he noted the sizes and shapes and styles of the ears around him. He grew to recognize hundreds of unknown people by their ears. Dinner guests at his home became used to the invitation: "Now, let's get a picture of your ears!" as they retired from the table. Year after year, he photographed the ears of his family, his patients, his friends.

In all, Dr. Kilmer has photographed and compared upwards of three thousand different ears. And no two, in all that number, were alike. More than that, he found that the right and left ears on the same head are always different, contrary to long-held opinion. The more pictures he took, the more sure he was that he was on the trail of a new means of accurate identification.

His tests have shown that the human ear changes little from childhood to old age. He has compared pictures of children's ears with the same ears later in life. During his decade of research, he has repeatedly examined and photographed the same ears and found they remained identical year after year. Thus, a person kidnapped in childhood and recovered years

afterwards, might be identified by his ears.

Ear Classifications

If Dr. Kilmer's discoveries are applied by criminologists, the chattering teletypes and police radios of the future may broadcast descriptions of fleeing criminals that contain some such sentence as this:

"Watch for this ear: Flap, Lobeless, Eleven-O'Clock, Round, Shut."

Those cryptic words will mean much to the detective trained in the ear classifications worked out by Dr. Kilmer. There are five divisions.

In the first, the ears are divided according to their position on the head as seen from the front. "Close" ears are those that lie comparatively flat against the head; "flap" ears those that stick out. The second division contains the "lobeless" ears, ones growing right out of the skin above the angle of the jaw, and "lobe" ears, having the familiar fatty appendage at the bottom.

The third division denotes the manner in which the ear is attached to the head, that is, whether it is straight up and down, titled forward or titled

back. The axis of the right ear is compared to the hour hand on the face of a clock. If the ear is straight up and down, it is designated as a "twelve-o'clock ear". If the top is farther ahead than the bottom, so the ear appears tilting forward, it is called a "one-o'clock ear", and if it tilts back, it is an "eleven-o'clock ear".

The general shape of the ear, either "round" or "elliptical", forms the fourth division. The fifth designates whether the canal, or opening, of the ear is visible in a side view. In "open" ears, the canal is visible; in "shut" ones, it cannot be seen.

By broadcasting such information, the search for a wanted man is instantly narrowed down. Just as an officer on the lookout for a stolen car with an Indiana license plate ignores all machines with other plates, so the detective searching for a criminal will eliminate all suspects with entirely different ears, thus saving time and avoiding the arrest of innocent persons. And, while an auto-thief can change his license plates, a criminal can't change his ears to disguise himself.

The chances of an innocent person having ears that tally in all five respects with those of a wanted criminal are slight. Even then, the exact negatives of the "earograph" camera would expose the differences between them.

The "Earograph" Camera and Its Use

To get scientifically exact ear pictures, Dr. Kilmer had to develop a special camera for the purpose. At first, he tried fingerprint cameras but they were unsatisfactory. Finally, he constructed a black oblong box, fourteen inches in length and five inches square. It contains a three-inch lens located so it throws an image on the plate which is exactly the size of the ear being photographed to the fraction of a millimeter.

Within this oblong box, three tubular, 110-volt electric light bulbs flash on for the fraction of a second when a picture is snapped to provide the necessary illumination. The four by five inch window in the front of the camera is placed against the head of the person whose ear is being photographed so the ear is in the center of the picture. As the camera is always placed in the same position in relation to the head, the picture is always taken

from the same angle.

To test the accuracy of his apparatus, Dr. Kilmer photographed various patterns of wall-paper, placing the negatives over the originals to see that they matched in every particular. On half a dozen different days, he took pictures of his son's right ear. Tests later revealed that these six negatives were identical. No matter when or where the pictures are made, the "ear-ograph" camera records the same ear exactly the same.

Photographs made in San Francisco, California, and in Portland, Maine, if the person is the same, will coincide absolutely and establish identity beyond a doubt. However, when different ears, that appear identical to the naked eye, are photographed and the negatives placed one on top of the other, differences instantly stand out that set them apart. In making his pictures, Dr. Kilmer always photographs the right ear. This coincides with the ones shown in the center of standardized side views of the rogues' gallery.

Chapter VII

PHOTOMICROGRAPHY
AND IT'S EVERY DAY USE
IN THE SOLUTION OF CRIME

The Microscope

And its Universal Applicability

When the Sherlock Holmes of today wipes the lens of his microscope, he is rubbing the Alladin's Lamp of criminology. In almost every realm of crime detection, it plays its part. It scrutinizes dust and hair and fibers. It reveals spurious gems and counterfeit coins. It makes the scientific study of handwriting, typing, and printing possible. Fingerprinting depends upon it. And the amazing story of forensic ballistics, the study of markings left on fired bullets, could never have been written without its aid.

New Tools for the Microscope Detective

To help the work of the microscope sleuth, new equipment is constantly being devised. For night investigations, a Detroit concern is marketing a combined flashlight and magnifying glass and a New York manufacturer has developed a glass ringed with small electric bulbs. Powerful folding microscopes are available for field work; comparison instruments, with double lenses showing two objects overlapping for special study, are made in many sizes; and compound instruments that give 1,200 magnifications have been designed in compact form for use

in makeshift laboratories. The tools of the trade now range from pocket glasses, smaller than a quarter, to a colossal apparatus, tall as a man and weighing half a ton.

The May "Magnascope"

This giant of the laboratory was devised by Luke S. May, famous in the Northwest as a scientific solver of mysterious crimes. It enlarges an object 5,000 times. Looking through this immense "magnascope", one sees a human hair looking like a telephone pole, a speck of dust looming up like a massive boulder, and the finest stroke of a steel pen stretching like a wide black ribbon on a white background.

It was this "magnascope" that figured prominently in a strange bit of scientific crime detection a couple of years ago. On a lonely road near Tacoma, Washington, a nine-year-old child was found brutually murdered. The slayer had hidden in a blind which he constructed of branches cut from trees with his pocketknife. Police rounded up suspects.

Taking their pocketknives, May carried them to his laboratory. One after the other, he clamped them in an elaborate mechanical arm which sliced the blades through branches at the exact angle at which one of the limbs used in the blind had been cut. The results, enlarged 5,000 times by the "magna-

scope", showed that one knife left identical marks on the wood. In addition, the giant lens of the laboratory revealed that the tiny tip of a fir needle, found on the clothes of the owner of the knife, exactly matched the remaining part of the needle found at the scene of the murder! A quick conviction followed.

Even more spectacular was another feat of this famous microscope-using criminologist--his brilliant work, a few years ago, in connection with the following case.

<u>The Mystery of the Thirteen Matches</u>

A little after one o'clock in the morning, the wife of an Idaho mine official sat up in bed frozen with fear. She had been awakened by the stealthy creaking of a door. It was pitch dark. Her husband had been called away and she was alone in the house. She heard the intruder feel his way across an outer room and fumble in a cabinet where $600 had been hidden for deposit the following day. Then at the top of her voice she screamed.

The frightened burglar, the money in one hand blundered toward the window, mistaking it for the door. Then he struck a match, got his bearings, and rushed into the night before neighbors could arrive. The woman had not seen his face. The

county sheriff, unable to find a single clue, gave up the case as incapable of solution. Then Luke S. May was called in. His first question was:

"Where did he strike the match?"

"There, by the window," he was told.

Everything had been left as it had been on the night of the burglary. Beside the window, two chairs were tilted against the wall. And on the floor beside them was not only one match, but thirteen.

On the evening before the robbery, the mine official and a friend had sat smoking by the window for hours, tossing used matches on the floor. May carefully gathered up the thirteen little sticks in his hand. Luck was with him. Twelve were grooved in the shafts. The thirteenth was round and crimped at the end.

"This is the one I want," he said, and turned to a powerful portable microscope. Under it, he studied the tiny stick. A minute stain of grease, a speck of coal dust, a glint of metal, a filing composed of iron and brass used in brazing, a particle of strange fiber unlike any in May's extensive collection, told their story. Ten clues he found on the single match. Calling at the engine rooms of the seven mines in the vicinity,

the detective learned a cylinder head had blown out at one on the day before the robbery.

"Where's the man who did the filing on that brazing job?"

A workman was brought in and from under his finger nails May scraped bits of coal dust and specks of iron-brass filings. He then stripped off the man's work clothes and revealed a second suit, of unusual make and texture. In the pockets he found matches, round ones crimped at the ends. Bits of fiber taken from the lining of the pockets proved identical with the mysterious thread particles discovered on the thirteenth match. Before they reached the sheriff's office, the captured thief confessed his guilt. Out of the 700 men in that Idaho mining town, May had picked the guilty one with a single match as his only clue!

The Study of Dust and Bits of Metal

Because bits of dust and metal are so often vital to the solution of a baffling crime, special attention is being given to their study in the scientific crime laboratories of Europe and America. The famous French microscopist, Dr. Severin Icard, has just announced remarkable success in identifying the work a person is engaged in by studying the dust in his watch.

Granules of carbon, for instance, are always found in the

watches of garage mechanics and coal workers, particles of metal in those of machinists, and grains of clay in those of masons. In the timepieces of barbers are tiny fragments of hair and in those of violinists specks of rosin.

In Germany, scientific sleuths of Berlin have made similar studies, analyzing the occupational dusts found in clothing. For months, one French detective analyzed the dust particles he discovered in the eyebrows of criminals, and another studied specimens found in the wax of the ears. Part of the laboratory equipment of the expert scientific detective is a collection of dusts for comparison purposes.

Scratches and Knife Marks

Another dramatic phase of this battle against the criminal, in which gleaming lenses play a leading part, is the study of scratches and knife marks.

Not long ago, a scientific detective in the West traced a threatening letter to the sender by means of microscopic knife marks left on a lead pencil shaving[1]. The bit of wood accidentally found its way into the envelope in which the letter was mailed. Photomicrographs of the infinitesimal grooves and ridges on the shaving corresponded in every detail with similar markings made by a jackknife taken from the pocket of a suspect.

In recording the markings left by larger knives, hatchets, and axes, the cutting tools are sliced through a block of beeswax, the cross sections of the block recording a perfect picture of the identifying ridges and grooves.

But scratches made by woodworking tools are not the only ones to give the trained sleuth illuminating clues. Those on metal are important, also. Take a recent case in California!

A pair of clever lock breakers, preying upon telephone pay stations, had reaped a rich haul in towns along the coast. For six weeks they carried on their raids, opening the coin boxes with special punches and screw drivers and escaping before the thefts were noticed. Finally, police nabbed two young men in a Seattle, Washington hotel. Hidden under the mattress in their room were punches and other tools. That was the only evidence against them, however, insufficient for a conviction.

A scientific detective was asked to examine the tools. Under his high-powered microscope, scratches on the last-robbed coin box and those produced by the confiscated tools jibed to the tiniest detail. In the space of an eighth of an inch, his lens revealed 100 major identifying marks, some only one ten-thousandth of an inch wide! On the strength of this amazing, subvisible evidence, the two suspects stayed in jail.

The "Hammer Murder Case"

Gust-driven rain was lashing the big elms in front of the country house in New Jersey hills on the night David Winter was murdered. That fact, by a curious chain of circumstances, led to the single, astonishing, microscopic discovery that sent his slayer to the electric chair.

In the house at the time of the crime were a twenty-year-old nephew, the housekeeper, and a chauffeur who had been in the employ of the wealthy widower for many years. All declared they had retired early, leaving the old man going over his accounts by the fire. They had heard no unusual sounds during the night. Yet, the next morning, the housekeeper found the body of her employer slumped in his cretonne-covered armchair, his skull crushed by a blow from a bloodstained hammer that had been dropped beside him.

Taking charge of the case, a scientific detective examined the hammer handle. At a point where the first finger of a gripping right hand would come, he discovered a smear of dried blood. He studied it through a magnifying glass. There were no fingerprints. The murderer had worn gloves.

He demanded to see all gloves in the house. The chauffeur explained that his had been ruined the day before by acid spilling from the auto battery. Leading the way to the garage, he

pointed out a pile of rags where he had thrown them. The detective rummaged in the pile, found the right glove, and carried it to the light. His eyes narrowed. The entire tip of the first finger had been eaten away with acid.

Apparently balked by this clever ruse, he raced to his laboratory with the glove and the hammer. There with a powerful compound microscope, he set to work. In three minutes, he had discovered an extraordinary thing, and in less than an hour, he held in his hands two dripping films, photomicrographs which solved the mystery of the murder and brought the killer to justice.

One film showed a magnified picture of a tiny elliptical spot where the wood grain lay bare on the hammer handle. The cutter on the lathe had missed this spot due to a depression in the stock from which the handle was turned. The other film showed a similar ellipse packed with wavy lines, the magnified picture of an impression stamped into the palm of the glove when the slayer gripped his murderous weapon. The chance fact that it had rained and his gloves were damp made the impression, when seen under the microscope, abnormally clear. Placed on top of each other, the pictures matched like two prints from a single film.

Later the guilty chauffeur confessed that his employer had discovered thefts extending over several years and had threatened to turn him over to the police unless he made restitution. Planning his crime so there would be no noise, he had crept up behind his victim, while the storm howled outside, and had killed him with a single blow. By using acid to eat away the one stain on the finger of the glove, he thought he had destroyed all visible evidence of his guilt. He had. But invisible evidence, revealed by the magic of the microscope, tripped him up and brought a quick conclusion to the "perfect crime".

Again, the versatile microscope plays a part in crime-solving by examining fibers and threads when fabrics have been cut or torn. Seen under a high-powered lens, a cut that looks perfectly straight to the naked eye appears as a jagged line. When the two halves are placed together, the thousand and one projections and indentations dovetail.

By this test, a murderer who wrapped his victim's body in a strip of canvas was run to earth. In another case, the revolver of a gunman was traced through a strip of tape wound around the handle. One end of the strip, under the microscope, matched the end of a roll from which it had been torn in the house of the suspect.

Chapter VIII

PHOTOMICROGRAPHY
AND ITS USE
IN THE STUDY OF FORENSIC BALLISTICS

Photomicrography and Its Use in the Study of Forensic Ballistics

Forensic ballistics, as the study of bullets and firearms is technically called, is now a mainstay in solving crimes of violence. Only seven years ago, the Supreme Court of the state of Illinois handed down a decision to the effect that it was preposterous for any man to say that he could trace a fatal bullet to the one gun from which it came. A few months ago, this same court completely reversed its stand and acknowledged the great value of forensic ballistics in solving mysterious murders.

Every rifle and revolver leaves its "finger print" on the lead or jacketed bullet it fires. A speck of rust, a minute island or valley of metal, a scratch on lead a thousandth of an inch deep, a dent in brass too small for the human eye to see, invisible gas deposits in the pores of a hand, any one of these things may lead to the conviction of a desperate criminal and solve what appears to be a baffling mystery. The ballistics expert, peering through his microscopes, sees much that the naked eye would miss, and these pictures are indelibly recorded, for later presentation to a jury, by the

photomicrograph camera.

The New Years Bullet Murder Case[1]

One of the strangest cases in the annals of scientific crime detection was the so-called New Years Bullet Murder Case, in which a bit of buried lead convicted a slayer who had covered up his tracks and even destroyed the weapon he used.

Shortly after eleven o'clock on a night when a dense fog lay over the city, the janitor of a New Jersey apartment house was retiring when he heard loud voices in the hallway above. There followed the crack of a pistol and the sound of running feet. Rushing up the stairs, he found one of the tenants slumped on the floor, dead. Before he could reach the front door, the murderer had disappeared in the white mist.

Eighteen hours later, detectives arrested a man boarding a train for the south. He was known to have had a grievance against the victim and, some months before, had been in court for stealing a revolver from a physician. This gun had never been recovered and police suspected that it might

[1] Popular Science, Feb., 1932, page 35

be the weapon that fired the fatal bullet. But, unless they could find the revolver, or a bullet known to have been fired from it, it would be impossible to prove their case by comparing the markings left by it with those on the lead taken from the body of the murdered man.

At this point in the case, one of those strange twists of fate that sometimes come to the aid of a scientific sleuth made the comparison possible. The doctor who had owned the gun recalled that some years before he had celebrated New Years Eve by firing a shot into the ground from his front porch.

An hour after the police had been notified of this fact, officers armed with shovels and screens descended upon the doctor's front lawn. Carefully sifting each spadeful of dirt, they recovered the precious bullet and carried it, as though it were a gold nugget, to the laboratory of the firearms expert.

He cleaned away the encrusted shell of dirt and vegetable matter and compared the fine scratches on its side, under his microscope, with

those on the fatal lead. They tallied exactly. Although the guilty suspect had destroyed the lethal weapon by hurling it into a roaring factory furnace, the dramatic appearance of the long buried New Year's Eve bullet convicted him of the murder.

In ordinary cases, the expert is given the suspect's weapon with which to shoot trial bullets for purposes of comparison. Deep baskets are filled with loosely packed cotton waste and into them the test bullets are fired. They are stopped, undamaged, after penetrating for twelve or fifteen inches and are then removed to be marked, usually on the base, as test bullets. Captain Van Amburgh, firearms expert for the Massachusetts State Police, prefers to fire test bullets into cakes of soap, because soap has the same consistency as human flesh. This method, however, although used by several other ballistics experts of national repute, has not become as widely used as that first described.

<u>Tracing the "St. Valentines Day Killer"</u> [1]

In the city of Chicago, Illinois, the police

[1] Popular Science, Feb., 1932, page 35

are greatly aided in their battle with the gangsters by the work of the Scientific Crime Detection Laboratory of that city, headed by Colonel Calvin Goddard, created some years ago to combat the crimes which have almost become a synonym for the name of that midwestern city.

One of the most famous feats of forensic ballistics was Colonel Goddard's tracing of fatal bullets in the atrocious "St. Valentines Day Massacre" to the machine gun of the bloody "journeyman murderer", Fred Burke.

On February 14, 1929, seven members of the Bugs Moran gang of beer runners were lined up against the wall of a Chicago garage and riddled with machine gun bullets by rival gunmen. The deadly bits of lead taken from the bodies, and the shells found scattered on the floor of the murder chamber, were turned over to Colonel Goddard. He compared the markings on them with those made by a score of gangland guns taken in various police raids which followed the murders without finding any that tallied.

Ten months passed. Then, one day, two automobiles collided on a street in St. Joseph, Michigan.

The resulting argument attracted the attention of the policeman who suggested that both drivers go to headquarters and settle their differences there. At this, one of the drivers jerked a .45 calibre automatic from his pocket and killed the policeman in his tracks, leaped on the running board of a passing car, pressed the gun against the ribs of the driver, and made his getaway.

Papers in his abandoned automobile showed that he was Fred Burke and led to a search of his home. In a closet, police found a veritable arsenal of machine guns. Colonel Goddard tested them in his laboratory and found one that left markings identical with those on the St. Valentines Day bullets, proving that Burke was the underworld butcher who operated the machine gun in the Chicago death garage. This case attained nation wide notoriety because of the audacity of the crime and the number of men killed. The method used to trap the killer is today common police practice.

<u>Tracing Bullets to the Guns That Fire Them</u>

How is anyone able to pick one gun and say: This fired the fatal bullet? Let us examine the methods followed by Colonel Goddard and other

nationally known firearms experts in the solution of this question.

Any fatal bullet, upon being removed from the body of a victim is carefully kept and marked, usually by an "F" scratched in the base, for later comparison with test bullets fired from guns taken from suspects, and marked usually with a "T".

In examining any two bullets fired from the same gun there can be seen, at regular intervals around the sides of each, the slanting streaks of fine scratches. These are made by the "lands" and "grooves" of the spiral rifling in a gun barrel that spins the bullet in order to keep it in a straight course and prevent it turning end over end after it leaves the muzzle. Fortunately, this rifling is different in different makes of guns. The width of the grooves varies and the number ranges from two to eight. In some guns they turn to the right, in others to the left.

They also vary in "pitch", or the angle at which the grooves are cut. For example, the grooves in a Colt revolver make one complete turn in sixteen inches; those in a Smith and Wesson one in eighteen

and three-fourths inches. Colonel Goddard employs an elaborate mechanism, the "helixometer", to determine the pitch of a suspect's weapon when it is not known. While the gun barrel slowly revolves, a tiny spotlight on the helixometer follows the rotation of the grooves. On fatal bullets, the pitch of the gun that fired them is determined by studying the angle of the slanting scratches.

Thus, by noting the number of groove marks, their width, pitch, and direction of rotation, the expert can tell the make of gun that fired a fatal bullet. Then the delicate expert work with the microscope begins to determine which of the suspected guns of the make known to have fired the bullet actually was used in the killing.

On little turntables under the two lenses of a comparison microscope, Colonel Goddard places the "fatal" and the "test" bullets. Then, as one looks through the single eyepiece of the instrument, the bullets appear to overlap each other. Turning one on its platform until a prominent scratch is uppermost, Colonel Goddard then slowly revolves the other until a similar scratch appears.

When the two meet and form a continuous line the two bullets are then turned slowly at equal speeds in order to see if each mark on the "fatal" bullet has its duplicate on the "test" bullet. This will inevitably follow if both bullets were fired from the same gun.

When guns are rifled at the factory cutters shaped like knitting hooks are pulled through the barrels to channel out the grooves. No two cutting edges in the world can be identical. Under a microscope they appear saw toothed with the humps and hollows arranged differently on different cutting edges. Consequently the bottom of the groove that is cut in the barrel of the gun contains microscopic ridges and valleys that leave their mark on every bullet that passes through the barrel.

Moreover, the cutters continually wear away and change, so the markings left on different guns by the same tools are different. Not long ago, at the Springfield Armory, in Massachusetts, bullets were fired through four rifles that had been made one after the other on the same machine. The markings

on the bullets were so different that each bullet could be traced to the gun that fired it.

Beating the firearms experts is now one of the first considerations of the underworld. Gangland killers throw away their guns after every murder to prevent identification. In Chicago, steel ball bearings, which carry no telltale markings, have been used in place of lead in several gang slaughters.

A Gun Leaves Its "Fingerprints" Upon Cartridge Shells As Well As Bullets [1]

Probably the most carefully planned attempt to outwit the skill of the firearms detective occurred a few years ago in an eastern city. Because of the unusual setting of the crime, it formed headline news throughout the country.

In mid-afternoon, on the main street of the city, an undertaker was mysteriously murdered at his place of business. The only clue to the slayer was a .32 caliber shell lying on the floor beside the body. Robbery was eliminated as a motive, as the cash register was untouched. No one had heard a shot.

It was believed the unknown assassin had

1 Popular Science, Feb., 1932, page 126

entered the establishment, fired the fatal shot, and made good his escape when the noise and excitement of a political parade, passing the door, was at its height. The dead man had no known enemies. It seemed likely that "unsolved" would be the final notation after the case on the police records.

Two weeks passed without a clue. Then detectives raided the rooms of a man suspected of running a gambling house. In his private desk, the officers found sheaves of newspaper clippings all relating to the baffling "Mortician's Murder Mystery." The man, closely questioned, admitted owning a .32 automatic and readily turned it over to the police.

When a ballistics expert compared the markings left by the barrel of this weapon with those on the fatal slug, he saw the pattern of the scratches was entirely different. But, the markings left on the empty cartridge by the breechblock were identical with those on the base of the shell picked up at the scene of the crime. The scientific detective declared the chances were less than one in a million that any other gun in the world had figured in the murder.

Then a young sleuth, who had been investigating the recent activities of the suspected man, uncovered an interesting fact that proved the statement by the expert was right. On the day after the killing, the gambler had sent a rush order for supply parts for his automatic, including a new barrel. Knowing the skill of firearms experts in tracing down the weapon used in a murder, he had substituted a new barrel after the slaying so the markings his gun made on lead would differ from those on the fatal bullet. However, he overlooked the fact that a gun leaves its "fingerprint" upon cartridge shells as well as bullets.

The confession of the killer revealed that, unknown to his family, the undertaker had incurred heavy gambling debts and then had repudiated them. The gambler had gone to collect the money on the day of the crime. In the argument, he had fired a single, fatal shot. The blare of horns and the shouting of the crowd outside the funeral parlor had drowned out the sound of the automatic. He had then slipped away unnoticed and after substituting a new barrel on his gun, thought himself safe. But

microscopic valleys and infinitesimal islands on the base of the fatal cartridge, which his weapon had ejected at the time it was fired, betrayed him.

Every time a gun is shot, the explosion that drives the bullet forward jams the cartridge shell back against the breechblock with equal force. In some cases this recoil is as great as 10,000 pounds to the square inch. The metal of the cartridge base is softer than the steel of the breechblock, so every irregularity of the steel surface is imprinted indelibly upon it, just as an impression is stamped into soft wax. As the breechblocks are finished in the factory by filing, and as, under the microscope, no two file marks are identical, each block stamps on the cartridge a signature that can't be forged.

Not only does the breechblock leave its telltale imprint, but the ejector, which throws out shells in an automatic, and the extractor, which pulls them out in a revolver, also leave markings on the softer metal of the shells that frequently aid the firearms sleuth. Again, the circular craters left by the firing pin tell their story.

The Use of the Stereoscope

Recently, a parlor toy of the '90's, the stereoscope, has been employed by the firearms expert to convict criminals. Dr. J. H. Mathews, Director of the Department of Chemistry at the University of Wisconsin and a noted scientific crime investigator, has developed a method for showing juries a true perspective image of firing pin marks on shells. By reproducing the photomicrographs on cards and inserting them in the stereoscope, he enables the jurors to see the enlargement exactly as they would if looking through the high-powered microscope in the expert's laboratory.

Chapter IX

PHOTOMICROGRAPHY
AND ITS USE
IN THE DETECTION OF FORGERY

Photomicrography and Its Use In Detecting Forgery

Imagine the cross on a "t", one five-hundredths of an inch thicker on one end than on the other, trapping a forger! Or the tail of a single comma exposing an elaborate fraud! Imagine a fake will plot nipped in the bud through the shape of a dot above an "i", a cunning swindle stopped by the loop of an "e"!

Such amazing feats are not taken from the pages of fiction. They are facts. They are on record in the files of scientific criminal hunters throughout the world. The story of these handwriting experts and their relentless battle to outwit the crooked penmen is an engrossing tale of applied science waging war against crime. In this battle, success often hangs upon strange and slender threads.

The Handwriting Detective And His Tools

To ferret out in the laboratory distinguishing differences of penmanship, the handwriting detective employs an elaborate scientific apparatus. Strong lights placed beneath glass-topped tables permit minute study of documents. Special magnifying

cameras record the strokes and curves of writing and enable the expert to measure them precisely with micrometers accurate to 1/10,000 of an inch. Chemicals and rays reveal the composition of inks and papers. Using such tools, the expert studies every word of a questioned document.

No matter how carefully a forgery is executed, there is almost always something that trips it up. Even the way an "i" is dotted may solve a case under the microscope of the skilled Sherlocks of the laboratory.

As a matter of fact, "Case No. 727" in the files of Luke S. May, the noted scientific criminologist of Seattle, Washington, records just such a feat. Early in April, 1930, Fred Zimmerli, a retired Swiss tailor, died in Seattle leaving a will in his safe deposit box dated February 23, 1928. It bequeathed one-eighth of his $30,000 estate to a daughter by a first wife, living in St. Louis, Missouri, and the rest to relatives in Switzerland.

Shortly after the daughter was notified of the terms of the will, she telegraphed the executors of the estate that she had found a later document, dated

August, 1928, hidden in one of the shirts that had been sent to her with her father's effects after his death.

In the resulting battle to have this later will recognized, Luke S. May gave sensational testimony in court.

A microscopic examination of the signature on the "shirt will", he declared, showed that both dots over the "i's" in the"Zimmerli" were made in a peculiar manner. Each had been made with two strokes of the pen, so they resembled a contracted "V" under the lens. Precision measurements further revealed that these spear-shaped dots were both made at exactly the same angle. A study of one hundred and fifty real Zimmerli signatures showed that although the dots on the "i's" were triangular, he never dotted an "i" with two pen strokes and never made both dots at the same angle. On the strength of this scientific testimony, the "shirt will" was declared a forgery.

Presenting the Evidence
To the Jury

To demonstrate such microscopic bits of evidence, enlarged photo-micrographs are usually handed the

jury. Sometimes, an expert will throw his pictorial clues, highly magnified, upon a courtroom screen, by means of a projector, while he explains their significance to the jurymen. Enlarged pictures of this sort show which line was made last when two strokes cross. By proving that the tail of the "p" in "Joseph Farrell" was written over part of the signature of a witness on a will, J. Clark Sellers, Los Angeles handwriting expert, recently proved the document was a forgery. The discovery disproved testimony in court that the deceased, Farrell, had signed the will before the witnesses placed their signatures on the document.

Pressure Pictures

Another form of special photography, "pressure pictures", yields evidence against the criminal penmen in the laboratories of scientific sleuths. Light is directed over a document at an angle almost parallel to it, when the picture is taken. Erasure marks, and every indentation in the paper, stand out clearly under such lighting.

A picture of this sort recently cleared up a Chicago blackmail case. The final warning to the intended victim was printed in pencil on paper from

a cheap tablet. Detectives swooped down on the house of a suspect two hours after the note was received. Between the leaves of a large Bible, they discovered a tablet whose paper matched that of the anonymous letter. When the top sheet was photographed under a strong side light, the words of the blackmail note became visible, indented into the paper by the pressure of the pencil when the original was printed on the leaf above!

An even more astonishing case, in which "sidelight photography" figured, was solved in an eastern state. A business man, of dubious reputation, borrowed $500 and gave his personal note in return. The man who lent him the money saw him dip a pen into ink and sign his name on the note. A little later when he was putting the paper into his safe deposit box at the bank, his hand brushed across it and the signature disappeared as if by magic. He rushed back to the business man's office. He was gone, and the next day denied he had ever borrowed any money.

In his dilemma, the victim of the transaction sought help in the laboratory of a handwriting sleuth. This scientific detective photographed the note in a

strong sidelight. The resulting picture showed the faint lines of the signature indented into the paper by the pen, but they were too indistinct to prove the case in court. Then, the victim recalled that, at the time the note was signed, he noticed the ink was of a striking, deep blue shade. The detective was all attention.

"This color"? he asked swiftly mixing a white powder in water and adding a few drops of iodine. The whitish fluid turned blue.

"That's it"!

"Then we've got him"!

The detective explained that the "ink" was starch-water mixed with iodine. In chemical laboratories, iodine is used to detect the presence of starch. If a solution contains starch, it will take on a characteristic bluish hue when iodine is added. When an "ink" prepared from iodine and starch has dried, it rubs off like dust. But in drying, a little of the starch soaks into the paper.

The detective placed an evaporating dish filled with iodine over a burner, and held the paper in the purple vapor that resulted. When he took the note away,

the reaction of the iodine and the starch brought out the signature clearly enough to photograph it.

Chapter X

THE USE OF "BLACK LIGHT" AND OTHER LIGHT RAYS

Use of "Black Light" and Other Light Rays

Ultra-Violet Rays and Their Use In Detecting Forgery

If a vote were taken among handwriting sleuths as to the most valuable recent aid to their work, the ultra-violet ray would stand at the top of the list. Already, these queer, invisible vibrations of the ether have become ace assistants in forgery hunting. They bring out writing that has been chemically erased, they indicate the age of paper kept under different storage conditions, and they reveal invisible fingerprints that trap the writers of anonymous notes.

Not long ago, Luke S. May proved a typewritten contract had been altered by showing that the "9" in $49,000 responded differently under the bombardment of filtered ultra-violet rays from the other figures in the number. In changing the "0" to "9", the crook had used a typewriter whose ribbon seemed identical in color. But the chemical composition of the inks differed and the rays revealed the discrepancy. Again, May traced a libelous letter, damaging the business of a large company, through

ray-revealed chemical stains on the paper.

Probably the most dramatic feat of rays in connection with handwriting took place in a middle western laboratory, a few months ago. A document, believed to be a forgery, was under examination. To determine if there were any alterations in the printed body of the paper, the expert carried it to his "ray room." In this darkened chamber, he placed the paper under the lamp and switched on the invisible rays. Instantly, there appeared in a lower corner of the paper a glowing golden circle!

Under the action of "black light", different substances glow, or fluoresce, with distinctive colors. The whole document had been cleverly forged on a special printing press and the genuine seal removed from a real document and placed on the fraudulent paper by means of glue the exact shade of the seal. Only under the ultra-violet lamp was this deception noticed, the glue around the edges of the seal containing a chemical that burst into a vivid sheen when struck by the rays.

When writing is done with iron gall ink, the acid eating into the paper leaves a deposit of the

metal in the fibers. Such a paper, even after the writing has been completely erased with chemicals, can be placed under ultra-violet light and the words brought out distinctly enough to photograph.

To aid the modern detective, portable "black light" outfits, that can be plugged into any convenience outlet, are now available. Photographic equipment allows permanent pictures of clues as they appear under ultra-violet rays to be kept on permanent file. One Chicago manufacturer has placed on the market a violet light machine for installing in banks for examining checks and bills.

Erasures in "boosted" checks that are invisible in daylight appear instantly when placed within range of the rays, and counterfeit bills, shining a sickly green in contrast to the snappy blue fluorescence of genuine currency, stand out like a sore thumb. Tracing altered checks with rays, Dr. Goodman, three years ago, caught a skillful criminal who had mulcted one New York organization out of $180,000 in a single year. In a number of European banks, ultra-violet lamps are installed as part of the regular equipment.

Another place where these wonder-working rays have found new employment is in examining letters sent to and from prisoners. Secret writing about escapes or smuggling drugs or firearms becomes visible in black light. Formerly a hot iron was rubbed over suspected letters to bring out the secret words. Now such messages are read and the letter is allowed to go on to confederates outside who are caught when an attempt is made to carry out the plot. One common powder, aesculin, sometimes used in secret inks, responds to rays when it is so dilute there is only one part powder to five million parts water!

Polarized Light

So far, the giants among the detective rays have been those of ultra-violet. But others are important too.

Recently, polarized light — rays that have passed through prism screens and are vibrating in one direction only — has figured in a number of dramatic cases. Used with the petrographic microscope equipped with a special lens, a rare instrument which only a few experts can handle, it

Another place where these ultra-violet rays have been found use in investigations is in examining letters sent to and from prisoners. Secret writing about escapes or smuggling drugs or firearms becomes visible in black light. Formerly a hot iron was rubbed over suspected letters to bring out the secret words. Now this scorches the sheet and the letter is allowed to go on to unsuspecting convicts who are caught when an attempt is made to carry out the plot. The common poison, strychnine, sometimes used in murder cases, responds to rays when it is so dilute there is only one part powder to five million parts water!

Polarized Light

So far, the giants among the detective rays have been those of ultra-violet. But others are important too.

Recently, polarized light -- rays that have passed through prism and are vibrating in one direction only -- has figured in a number of criminal cases. Used with the petrographic microscope equipped with a polarized lens, a rare instrument which only a few experts can handle, it

is now doing remarkable work in tracing dust and minerals. Seen through this microscope, each mineral has its strange, distinctive pattern or interference figure.

The greatest triumph for this microscope, and the mysterious "one-way" light which makes its use possible, occurred recently. A middle-western farmer started on an auto trip with his son-in-law. The machine was found overturned on a lonely road, the old man, his skull crushed in, lying at the foot of a bloodstained rock.

The son-in-law, who was uninjured, said he had leaped clear just as the car turned turtle, but that the older man had been thrown from the machine, hitting his head on the rock. This story was accepted until a few days later when it came out that a large amount of accident insurance had just been taken out by the old man.

Authorities investigated. Finally, polarized light, in the hands of an expert with a petrographic microscope, revealed that the overturned car and the bloodstained rock were carefully-planned links in an atrocious crime. Bits of broken rock, extracted from

the head of the victim, cast an entirely different pattern from that given by pieces chipped from the bloodstained boulder. Confronted with this evidence, the son-in-law confessed that he had killed his victim.

X-Rays

If you mention the use of rays in crime detection, most people will think of solid-piercing X-rays, which often play a part. In laboratories where these penetrating vibrations stream from glowing tubes, frauds and plots are often exposed. Here, fake paintings are detected and spurious gems revealed. Imitation sapphires and rubies can now be made synthetically so they have the same light refraction, the same chemical composition, and even the same atomic construction as the real gems.

The only way to tell them apart, a German physicist has just announced, is to place them under powerful X-rays from a Coolidge tube. If the stones glow, they are genuine.

In the moat of an ancient fortress near Copenhagen, Danish police, not long ago, found the legless body of a woman. Extensive search among

the records of missing persons failed to identify her. The police decided to have the body X-rayed. One lung proved so badly infected with tuberculosis that they concluded the woman must have been a patient at some hospital.

A search of all hospital photographs followed. The X-ray record of one woman's lung so closely resembled that of the unknown victim that they followed up the clue. When they arrived at the address from which the hospital patient had come for treatment, they learned she had left two weeks before. Undaunted, they examined the furniture and found old fingerprints. These matched exactly those of the murdered woman. Sure of her identity, the police pressed on the trail, found a man with whom she had been associating, and obtained from him a confession.

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